Public Health Assessment

Cenex Supply and Marketing, Inc.
(a/k/a Western Farmers, Incorporated)
Quincy, Grant County, Washington
EPA Facility ID: WAD980726269
March 1, 2002

Prepared by

The Washington State Department of Health
Under a cooperative agreement with the
Agency for Toxic Substances and Disease Registry

Washington State Department of Health

Foreword

The Washington State Department of Health (WDOH) has prepared this public health assessment in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health assessment was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health assessment is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. WDOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

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Abbreviations/Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
CREG	ATSDR cancer risk evaluation guide
CSMI	Cenex Supply and Marketing, Inc.
CV	comparison value
WDOH	Washington State Department of Health
1,1-DCE	1,1-dichloroethylene
1,2-DCP	1,2-dichloropropane
Ecology	Washington State Department of Ecology
EMEG	ATSDR environmental media evaluation guide
EPA	Environmental Protection Agency
LOAEL	lowest observed adverse effect level
MCL	Safe Drinking Water Act maximum contaminant level
MCLG	Safe Drinking Water Act maximum contaminant level goal
MRL	ATSDR minimal risk level
µg	microgram
mg	milligram
MTCA	Department of Ecology Model Toxics Cleanup Act regulation
NOAEL	no observed adverse effect level
ppb	parts per billion
ppm	parts per million
PAHs	polycyclic aromatic hydrocarbons
PHA	public health assessment
RfD	oral reference dose
RMEG	ATSDR reference dose media evaluation guide
RI	remedial investigation
RCRA	Resource Conservation and Recovery Act
SVE	soil vapor extraction
USGS	United States Geological Survey
VOC	volatile organic compound

Glossary

Acute	Occurring over a short period of time. An acute exposure is one which lasts for less than 2 weeks.
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Aquifer	An underground formation composed of materials such as sand, soil, or gravel that can store and/or supply groundwater to wells and springs.
Cancer risk evaluation guide (CREG)	The concentration of a chemical in air, soil, or water that is expected to cause no more than one excess cancer in 1 million persons exposed over a lifetime. The CREG is a *comparison value* used to select contaminants of potential health concern and is based on the *cancer slope factor* (CSF).
Cancer slope factor	A number assigned to a cancer-causing chemical that is used to estimate its ability to cause cancer in humans.
Carcinogen	Any substance that can cause or contribute to the production of cancer.
Chronic	A long period of time. A chronic exposure is one which lasts for a year or longer.
Comparison value	A concentration of a chemical in soil, air, or water that, if exceeded, requires further evaluation as a contaminant of potential health concern. The terms comparison value and screening level are often used synonymously.

Contaminant	Any chemical that exists in the environment or living organisms that is not normally found there.
Dose	A dose is the amount of a substance that gets into the body through ingestion, skin absorption, or inhalation. It is calculated per kilogram of body weight per day.
Environmental media evaluation guide (EMEG)	A concentration in air, soil, or water below which adverse noncancer health effects are not expected to occur. The EMEG is a *comparison value* used to select contaminants of potential health concern and is based on ATSDR's *minimal risk level* (MRL).
Epidemiology	The study of the occurrence and causes of health effects in human populations. An epidemiological study often compares two groups of people who are alike except for one factor, such as exposure to a chemical or the presence of a health effect. The investigators try to determine if any factor (i.e., age, sex, occupation, economic status) is associated with the health effect.
Exposure	Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). Exposure might be short-term (acute) or long-term (chronic).
Groundwater	Water found underground that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater often occurs in quantities where it can be used for drinking water, irrigation, and other purposes.
Hazardous substance	Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.

Indeterminate public health hazard	Sites for which no conclusions about public health hazard can be made because data are lacking.
Ingestion rate	The amount of an environmental medium which could be ingested typically on a daily basis. Units for IR are usually liter/day for water, and mg/day for soil.
Inorganic	Compounds composed of mineral materials, including elemental salts and metals such as iron, aluminum, mercury, and zinc.
Lowest observed adverse effect level (LOAEL)	LOAELs have been classified into "less serious" or "serious" effects. In dose-response experiments, the lowest exposure level at which there are statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control.
Maximum contaminant level (MCL)	A drinking water regulation established by the federal Safe Drinking Water Act. It is the maximum permissible concentration of a contaminant in water that is delivered to the free-flowing outlet of the ultimate user of a public water system. MCLs are enforceable standards.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Minimal risk level (MRL)	An amount of chemical that gets into the body (i.e., dose) below which health effects are not expected. MRLs are derived by ATSDR for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.
Model Toxics Control Act (MTCA)	The hazardous waste clean-up law for Washington State.

Monitoring wells	Special wells drilled at locations on or off a hazardous waste site so water can be sampled at selected depths and studied to determine the movement of groundwater and the amount, distribution, and type of contaminant.
No apparent public health hazard	Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.
No observed adverse effect level (NOAEL)	The dose of a chemical at which there were no statistically or biologically significant increases in frequency or severity of adverse effects seen between the exposed population and its appropriate control. Effects might be observed at this dose but were judged not to be "adverse."
No public health hazard	Sites for which data indicate no current or past exposure or no potential for exposure and therefore no health hazard.
Oral reference dose (RfD)	An amount of chemical ingested into the body (i.e., dose) below which health effects are not expected. RfDs are published by EPA.
Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides, which are not easily dissolved in water.
Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition-size swimming pool, the water will contain about 1 ppb of TCE.

Plume	An area of contaminants in a specific media such as groundwater.
Reference dose media evaluation guide (RMEG)	A concentration in air, soil, or water below which adverse noncancer health effects are not expected to occur. The EMEG is a *comparison value* used to select contaminants of potential health concern and is based on EPA's oral reference dose (RfD).
Remedial investigation	A study designed to collect the data necessary to determine the nature and extent of contamination at a site.
Route of exposure	The way in which a person might contact a chemical substance that includes ingestion, skin contact, and breathing.
U.S. Environmental Protection Agency (EPA)	Established in 1970 to bring together parts of various government agencies involved with the control of pollution.
Volatile organic compound (VOC)	An organic (carbon-containing) compound that evaporates (volatilizes) easily at room temperature. A significant number of the VOCs are commonly used as solvents.

Executive Summary

The Washington State Department of Ecology (Ecology) requested that the Washington State Department of Health (WDOH) evaluate available environmental sampling data and prepare a health assessment for the Cenex Supply and Marketing, Inc. (Cenex) site, located in Quincy, Washington. The site has been used for the storage and distribution of fumigants.

WDOH has reviewed and evaluated the results of environmental samples collected by the U.S. Environmental Protection Agency (EPA), Ecology, and Cenex from the soil, soil gas, air, and groundwater at the Cenex site. In addition, data from the Washington State Cancer Registry were evaluated to determine if there were more cases of cancer among Quincy area residents (i.e., ZIP code 98848) than would be expected. After careful review and evaluation of these data, WDOH concluded the following:

➤ WDOH evaluated potential past, present, and future exposure to contaminants detected in the soil at the Cenex site. Contaminants were not at levels expected to result in adverse noncancer health effects, and estimated increased cancer risks were low. For the evaluation, workers and residents were assumed to be chronically exposed to elevated levels of some herbicides, pesticides, and metals that were detected in soil at the Cenex site prior to removal and capping with clean gravel. Current soil contaminant levels are much lower, and do not represent a public health hazard.

➤ EPA's particulate emission model was used to evaluate potential past exposures to contaminants in dust generated at the Cenex site. The estimated health risks from these exposures was low.

➤ A low level of 1,2-dichloropropane (1,2-DCP) was detected in indoor air in one room at the Quincy high school during a February 1998 investigation. The detection was below a level expected to cause chronic health problems for most people. More comprehensive and sensitive follow-up indoor air sampling conducted inside the high school in August 2000 found no 1,2-DCP or other chemicals at levels of health concern. Additional indoor air sampling was conducted inside Quincy high school in November 2001, the results of which will be evaluated by WDOH in a separate health consultation.

➤ Past exposure of students and staff at the junior high school to overspray from the former Cenex rinsate pond spray system represents an indeterminate public health hazard. No air sampling of the overspray mist was conducted during its brief operation, so measurement of staff and student exposures is not possible. However, based on the concentrations and the limited number of chemicals detected in a rinsate pond sample, and the limited timeframe in which the exposures would have occurred, a long-term health risk is not expected.

- Contaminated groundwater from the Cenex site does not represent a public health hazard, as it is not being used for domestic (i.e., drinking and cooking) purposes.

- Based on WDOH's analysis of the 24 major types of cancer, using all 7 years of available data (1992-1998), overall, there were fewer total reported cases of cancer in Quincy during this time period than would be expected in a community in Washington of the same size and age structure. A more detailed discussion of this analysis is presented in the Health Outcome Data Evaluation section of this health assessment.

Purpose and Health Issues

This public health assessment was prepared at the request of the Washington State Department of Ecology (Ecology) to evaluate potential exposures of workers and residents living near the Cenex Supply and Marketing, Inc. (Cenex) facility to hazardous substances released into the environment. Cenex and previous owners/operators at this location have a history of controlled and uncontrolled releases of fumigants and other pesticides to the environment that might have resulted in exposures of workers and residents. This assessment evaluates the potential past, present, and future health threats.

Background

A. *Site Description and History*

The Cenex site is located in the city of Quincy, Grant County, Washington, south of the Burlington Northern railroad tracks, on the north side of Division Street, between Fourth Avenue S.E. and Sixth Avenue S.E. (Figure 4). Quincy (population 3,715) is located in the east-central part of the state, in the northwest portion of the Columbia Basin Irrigation Project, at the southern base of the Beezley Hills (Figures 2 and 3). Cenex employs approximately 27 people at the Quincy facility. Adjacent facilities include other agri-chemical and fertilizer businesses, and seed, grain, and fresh-pack potato processing facilities. The nearest residential area is approximately 160 yards southeast of the site.[2]

Quincy has five municipal supply wells; three online and two standby wells, that draw water from a deep (from 381 to 409 feet below ground surface) basalt aquifer (Figure 8). The closest municipal well (Well # 5) is approximately one-half mile east-southeast of the Cenex site. The nearest known domestic well is a closed well at the railroad depot, approximately 170 yards from the site. A public high school and a junior high school are located 195 yards and 225 yards from the site, respectively.[2] Population demographics within a quarter-mile radius of the site are presented in Figure 1, Appendix B.

The site was occupied by a livestock operation in the 1950s that later closed, and then was vacant until 1974. At that time, a liquid fertilizer and soil fumigant storage and distribution facility was established by Western Farmers Cooperative. A storage area at the site, consisting of multiple tanks, was constructed on a concrete slab and surrounded by an earthen berm. Fumigants stored at the site included DD (dichloropropane, 1,3-dichloropropene), DD with chloropicrin (dichloropropane, 1,3-dichloropropene, and trichloronitromethane), Telone (1,3-dichloropropene and related C3 hydrocarbons), and Telone C-17 (1,3-dichloropropene, trichloronitromethane). Several fertilizers were also stored at the site. The tanks were plumbed to an electric pump within the earthen dike, and from the pump to hoses which were located beyond the dike for loading and unloading trucks, nurse tanks, and application apparatus at street level outside the containment area. Spillage from these hoses onto the soil outside the earthen berm might have occurred on the south side of the containment facility.[3, 4]

The facility was taken over by Cenex in 1982, and used for storage and distribution of fumigants including Telone, Telone II, Telone C-17, and Metham-Sodium (sodium N-methyldithiocarbamate). Some tanks were used for liquid fertilizer storage until 1985 and included UAN 32-0-0 (urea ammonia nitrate, 32% free ammonia, 0% ammonium nitrate, 0% urea), Aqua Ammonia, and 9-30-00 (9% nitrogen, 30% phosphorous and 0% potassium).[3]

The extent of past releases by Western Farmers Cooperative and Cenex is unknown. In 1986, fumigant hoses were fitted with dry connections to prevent releases into the environment. Once the dry connections were fitted in 1986, the potential for release from the hoses was significantly reduced. No record exists of other herbicides being handled or stored on the site prior to 1986.[3, 4]

Interviews with Cenex employees suggest that an undocumented fumigant spill occurred shortly before Cenex acquired the site property in 1982.[4, 5] Reportedly, approximately 2,000 gallons of Telone were released during that incident. Although the product was contained within the bermed area, it reportedly soaked into the ground under the fumigant storage facility. No known effort was made to recover the product.[4]

In 1986, Cenex installed a rinsate collection system to contain herbicide, pesticide, and fertilizer rinsate water generated while cleaning and rinsing application equipment and pesticide containers prior to disposal. The collection system consisted of an elevated concrete containment pad which drained to a concrete containment pond. The rinsate pond was located directly west of the fumigant storage facility and had a capacity of approximately 55,000 gallons. No records exist of any disposal activities for tank residual mixtures or rinsate waters prior to the installation of the rinsate collection pad and evaporation pond.[3, 4] Release of rinsate water might have occurred at the pond location prior to construction of the containment facility. The method of sealing the joints between the walls and floor of the pond is unknown. The pond was fenced, with a gate on the south side for cleanout.

After application equipment and pesticide containers were washed, contents of the pond were allowed to evaporate. However, because evaporation rates were slower than the fill rates, an aeration system was installed in 1986 to enhance evaporation. The system operated for about 6 months, but was ineffective. It was replaced by a spray system to enhance evaporation. The effectiveness of the spray evaporation system was marginal, and rinsate collection continued until 1988, when use of this facility ceased. In spring 1990, contents of the pond were tested and applied to a 100-acre Cenex-leased agricultural field, located outside of Quincy. Approximately 30,000 gallons of pond sludge were applied.[4, 6, 7] Rinse water used to clean the pond was also applied to the Cenex-leased field. The concrete walls were then pushed over and onto the rinsate pond floor, and surface soil surrounding the pond was used to fill it to grade. Operation of the fumigant storage facility ceased in 1991. Shortly thereafter, some of the tanks were moved from the containment area to an area just west of the rinsate pond site pending decontamination and salvaging. The site was fenced in 1996 to prevent access by nonemployees.

B. *Regulatory History*

In August 1991, the Washington State Department of Ecology inspected the Cenex facility and, in April 1992, issued Cenex an Administrative Order requiring development and implementation of a site assessment plan (SAP) for the area in and around the former rinsate pond.[4, 5]

The U.S. Environmental Protection Agency conducted a site assessment of the former rinsate pond area on May 10–11, 1993, to determine whether there had been violations of the Resource Conservation and Recovery Act (RCRA) and/or the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Results of the site assessment investigation were also used to derive a Hazard Ranking System (HRS) score for possible National Priorities List (NPL) ranking.[8] The site assessment included collection of four on-site surface soil samples, one background surface soil sample, and five sludge/soil samples from the excavated rinsate pond and from the perimeter of the pond. Samples were analyzed by standard EPA methods for the 45 herbicides present or previously used at the site, and for 63 volatile organic compounds (VOCs). One sample was also submitted for target analyte list (TAL) metals. Sample results are presented in Appendix A. Based on the soil and sludge sampling results, EPA determined that no further involvement was necessary. Since 1993, EPA has not been involved at the Cenex site.

On May 19, 1993, Ecology requested that Cenex properly dispose of the fumigant tanks and the sludge contained within the tanks. From August 1994 to February 1995, Cenex contractors, with Ecology oversight, decontaminated and removed all tanks of the former fumigant storage facility. A revised SAP that included the fumigant storage facility area and adjacent soil was completed on April 7, 1995.[9] On June 6, 1995, soil sampling was conducted at the site to address requirements of the SAP. Sampling locations included the rinsate pond, comprising soil above and below the concrete floor, the rinsate pond concrete floor and walls, concrete and soils within the fumigant storage facility containment area, soils surrounding the rinsate pond, and fumigant storage facility. A total of 85 soil samples were collected. Samples were analyzed for site-related herbicides, fumigants, and metals.[3, 5] The results are presented in Appendix A.

A total of 360 tons (277 cubic yards) of soil and concrete removed from the rinsate pond was stockpiled onsite, then transported to the Rabanco Landfill (a permitted hazardous waste facility) in Roosevelt, Washington, on May 1 and 2, 1997. The site was then wet down with a water truck, and clean gravel was placed over the site to suppress dust emissions.[3, 4, 5] In September 1998, Ecology and Cenex signed an Agreed Order, which required Cenex to install and operate a soil vapor extraction (SVE) system, institute a supplementary site investigation and pilot study, and perform groundwater monitoring to evaluate both the effectiveness of the air sparging technology and gather information on the nature and extent of chemicals in the groundwater. Between August and December 1998, all of the interim actions were completed (the installation of five additional monitoring wells, an SVE system, and an air sparging system). In November 1998, the SVE and air sparging systems began operating. These systems are intended to help remove contaminants from the shallow soils and to expedite degradation of contaminants in the groundwater underneath the site. To date, Cenex has installed and sampled 29 on-site and off-site groundwater monitoring wells, collected site and background soil samples, on-site and off-site subsurface soil gas samples, and on-site and off-site air samples. A Feasibility Study was finalized in May 2000 that describes the various cleanup alternatives. In early 2001, Ecology selected the final cleanup action based upon MTCA criteria. Ecology and Cenex Harvest States Cooperative entered into a Consent Decree to implement the clean-up action.

C. *Site Visits and WDOH Activities*

WDOH has conducted numerous site visits, has attended numerous public meetings, and has mailed periodic community update notices since becoming involved in 1997. WDOH has met with concerned residents, Quincy officials, Cenex environmental consultants, and agency representatives to share and discuss information relevant to the site. In 1998, update letters were mailed to area residents summarizing the preliminary findings of the health assessment. At a public meeting in Quincy in August 1998, WDOH summarized the preliminary results of the health assessment. A press release announcing the availability of the draft health assessment, and copies of the draft health assessment were distributed for public review and comment in spring 2000. WDOH was available to address health-related questions at a Quincy concern-sponsored public meeting in April 2000. A more detailed list of activities conducted by WDOH and other agencies is located in the public health action plan section at the end of this report.

Discussion

Environmental investigations conducted since 1993 have confirmed the presence of contaminants in Cenex site soils, on-site and off-site shallow groundwater, and on-site and off-site subsurface soil gas. A limited-scale indoor air sampling investigation was conducted in and around the Quincy high school in 1998, followed by more comprehensive indoor air investigations in the summer of 2000 and fall of 2001.

The following section discusses how WDOH evaluates risk, the *nature and extent of the contamination*, the *pathways of exposure*, and *the public health implications* from exposure to the contaminants of concern. In other words, what contaminants are present, how people might come into contact with them, and the potential health effects that could result from exposure to the contaminants.

Contaminants of concern were assessed using various state (MTCA method B)[10] and federal (ATSDR and EPA)[11, 12] health-based criteria (comparison values). Comparison values are media-specific concentrations used to select environmental contaminants for further evaluation. Contaminant concentrations below comparison values are unlikely to pose a health threat. Contaminant concentrations exceeding comparison values do not necessarily pose a health threat, but are further evaluated to determine whether they are at levels observed to cause toxic effects (referred to as toxic effect levels) in human population and/or laboratory animal studies.

Evaluating noncancer risk

To evaluate the potential for noncancer health effects, a dose was estimated for each contaminant exceeding a comparison value. In estimating exposure doses, *it was conservatively assumed that residents and workers were chronically exposed to the maximum detected contaminant concentrations in soil at the Cenex site, without regard to sample depth.* In some cases, these samples were below ground surface, where exposures would have been unlikely. The estimated child and adult exposure doses for each contaminant were then compared to ATSDR's minimal risk level (MRL) or EPA's oral reference dose (RfD). MRLs and RfDs are estimates of daily exposure of a human to a chemical below which noncarcinogenic health effects are not expected. They are derived from human and laboratory animal studies. These studies provide either a lowest observed adverse effect level (LOAEL) or a no-observed adverse effect level (NOAEL). In human or animal studies, the LOAEL is the lowest dose at which an adverse effect is seen, while the NOAEL is the highest dose that did not result in any adverse health effects.

RfDs and MRLs

Oral reference doses (RfDs) and minimal risk levels (MRLs) are levels of daily exposure to chemicals below which noncancer health effects are not expected. MRLs are set by ATSDR for acute, intermediate, and chronic exposure. EPA sets RfDs based on chronic exposure only. An MRL or RfD is derived by dividing a LOAEL or NOAEL by "safety factors" to account for uncertainty and provide added health protection.

To account for uncertainty (i.e., intraspecies variability, interspecies variability and extrapolation of a subchronic effect level to its chronic equivalent), the LOAEL or NOAEL is divided by a safety factor (typically from 100 to 1,000) to provide the more protective MRL or RfD. If a dose exceeds the MRL or RfD, the *potential* exists for adverse health effects. Thus, a dose only slightly exceeding the MRL or RfD would fall well below a toxic effect level. The higher the estimated dose is above the MRL or RfD, the closer it will be to the toxic effect level. It is important to note that new analytical methods are now being employed that better utilize scientific studies by considering all of the dose-response data rather than just the LOAEL or NOAEL.

Evaluating cancer risk

For screening of chemicals that are known or expected to cause cancer, it is assumed that no "safe" level exists, and EPA cancer slope factors are used to calculate an estimated increased cancer risk. The slope factor is used to estimate an upperbound probability of an individual developing cancer as a result of exposure(s) to a particular level of a carcinogen(s). An exposure which results in an estimated increased cancer risk of one additional cancer in a population of 1 million people exposed, averaged over a 70-year lifetime, is considered an acceptable risk, and is used as the comparison value. This one additional cancer is in addition to the approximately one in four persons in the U.S. expected to develop cancer in their lifetime.[13]

A. Groundwater

A1. Nature and extent of contamination

For the general area encompassing Quincy, the U.S. Geological Survey (USGS) classifies the groundwater system as part of the Columbia Lava Plateau groundwater region. Two basic aquifers exist in the region, a shallow, unconsolidated aquifer zone and a deeper aquifer. However, restricting or confining layers in the unconsolidated materials result in perched water tables much closer to the soil surface (Figure 7). Due to input from irrigation project waters, shallow groundwater elevation levels have increased significantly. Quincy's five municipal wells are screened in the deeper aquifer, at depths ranging from 381 to 409 feet below ground surface (BGS). Groundwater flow in the unconsolidated shallow zone in this region is toward the southeast.[3]

Since June 1996, Cenex has installed 29 on-site and off-site groundwater monitoring wells in the upper and lower parts of the shallow aquifer zone. Numerous VOCs and nitrates exceeding health comparison values and state and federal drinking water standards (maximum contaminant levels, or MCLs) were detected in the shallow groundwater. 1,2-dichloropropane (1,2-DCP) has been consistently detected at the highest concentration (up to 7,000 times the drinking water standard), although other VOCs have also been detected. Nitrate has been detected in groundwater underneath the site up to 28 times the federal drinking water standard. Monitoring well 9, an on-site well, was sampled for a full range of pesticides (EPA method 507 modified for pesticides) in September 1997, but none were detected. Maximum detected groundwater VOC and nitrate concentrations are presented in Table A5. The contaminated groundwater plume has migrated off-site, across Division Street and Sixth Avenue to the southeast (Figure 6).

______*A2. Pathways analysis and public health implications*

Although the shallow groundwater has been significantly contaminated by past site activities, *to date, these contaminants have not impacted the city's municipal drinking water supply wells.* After a thorough review of county well logs, followed by field inspections, representatives of the Grant County Health District could not locate any private domestic wells in the vicinity of the site. As a result of their investigation, no private wells are believed to be used for domestic purposes in the vicinity of the Cenex groundwater plume. Residents downgradient of the site (and most, if not all, residents within the city limits) obtain their domestic water from the city's municipal wells (Grant County and City of Quincy staff, personal communications, 1997). No VOCs were detected in the most recent (January 22, 2001) water samples collected from Quincy well # 5.

B. Air: Onsite

______*B1. Nature and extent of contamination*

VOC levels in ambient air at the Cenex site prior to site remediation activities in 1997 were limited to qualitative measurements taken with an Organic Vapor Analyzer (OVA). These measurements did not detect VOCs in on-site ambient air. Testing for 1,2-DCP at the Cenex property fence line with passive dosimeter badges also occurred during a limited-scale air sampling event in February 1998.[14] No 1,2-DCP was detected during this event. On-site air sampling for pesticides or metals was not conducted.

An air model was used to predict concentrations of VOC emissions prior to startup of the on-site SVE system employed in November 1998.[15] Air modeling results indicated that VOC concentrations were predicted to be below levels of health concern. The maximum modeled ground level concentration for these VOCs was estimated to be 24 meters from the stack.[15]

The SVE system was designed to remove VOCs, including the four primary contaminants of concern in the vadose zone vapors; 1,2-dichloropropane, chlorobenzene, chloroform, and vinyl chloride (i.e., VOCs previously detected during site subsurface soil gas tests).

After the SVE system became operational, air sampling for VOCs was conducted. VOCs were not detected in the stack effluent (i.e., the carbon system removed all VOCs). Modeled and measured air VOC concentrations, soil gas VOC concentrations, and health comparison values are presented in Table A8 and A9.

______*B2. Pathways analysis and public health implications*

On-site air sampling for VOCs was conducted on several occasions, as described above. *On the basis of the results of previous on-site ambient air sampling*, VOCs do not appear to be a health concern to workers or residents near the site. Additionally, site soil gas remediation has been in effect for several years, and is ongoing. The soil gas removal effort is intended to further reduce the likelihood of VOCs present in subsurface soil gas from entering the groundwater and ambient air.

C. Air: Off-Site

______*C1. Nature and extent of contamination*

February 1998 testing

Because of community and school concerns about the potential for exposure to 1,2-DCP inside the Quincy high school, Cenex conducted a limited-scale air monitoring investigation at the school between February 18–23, 1998. Cenex installed 11 3-M passive organic vapor monitoring badges in and around the high school to determine the levels, if any, of this chemical.[14] The badges were left in place for five days in an effort to achieve the required detection limit. 1,2-DCP, a primary chemical of concern, has been detected in soil, soil gas, and groundwater at the Cenex site, and in soil gas underneath the high school and adjacent Desert Electric property.

A low concentration of 1,2-DCP was detected in the staff lounge. The concentration was below ATSDR's minimal risk level (MRL), but exceeded EPA's inhalation reference concentration (RfC), and was further evaluated by WDOH to determine the potential health implications (see section C2 below).

RfCs

Inhalation reference concentrations (RfCs) are concentrations in air below which adverse noncancer health effects are not expected to occur. RfCs are set by EPA based on continuous (i.e., 24-hour/day) exposure.

August 2000 testing

In summer 2000, Cenex, with Ecology and school board oversight, conducted a more comprehensive indoor air investigation at the Quincy high school, the results of which were evaluated by ATSDR in a health consultation. *No 1,2-DCP or other site-related chemicals were detected during that investigation.* Several chemicals were detected, but were determined by ATSDR to be below levels of health concern. A similar, follow-up indoor air sampling investigation was conducted at the high school in fall 2001, the results of which will be evaluated by WDOH in a separate health consultation. The following section discusses the health implications associated with the 1998 1,2-DCP detection.

______*C2. Pathways analysis and public health implications*

Before the early 1980s, 1,2-DCP was used in farming as a soil fumigant and was found in some paint strippers, varnishes, and furniture finish removers. 1,2-DCP has also been used as a solvent, photographic processing chemical, and as an intermediate in the formation of other chemicals.[16]

Breathing high levels of 1,2-DCP can cause dizziness, headache, nausea, eye and throat irritation, and injury to the liver and kidneys.[16] There are no reports of health effects in humans following low-level exposure to 1,2-DCP for either short-or long-term time periods. Some animal studies indicate that inhalation of 1,2-DCP at high levels causes liver and kidney damage, as well as effects on the respiratory system.

EPA's RfC for 1,2-DCP is 4 $\mu g/m^3$, and is based on increased cell growth in rat nasal mucosa following chronic high dose inhalation exposure.[17] The 1998 detection in the staff lounge exceeded the RfC, indicating the possibility that continuous exposure over many years could result in adverse health effects for sensitive individuals. However, the level detected in the staff lounge was over 700 times lower than the lowest concentration at which actual health effects were observed in the studies used to derive the RfC. As a result, exposures would not be expected to result in chronic health effects for most people. As previously noted, more recent, and comprehensive indoor air sampling was conducted inside the high school in the summer of 2000. No 1,2-DCP or other site-related chemicals were detected during that event.

Although data exist on the carcinogenic potential from *oral* exposure to 1,2-DCP, data regarding the carcinogenic potency of 1,2-DCP following inhalation exposure are insufficient for estimation of carcinogenic potency.[16, 17] No studies were located in the scientific literature regarding carcinogenic effects in humans following inhalation exposure to 1,2-DCP. A 1948 mouse study examined the hepatocarcinogenic (liver) effects of 1,2-DCP from intermediate-duration (25–30 weeks) inhalation exposures. In that study, some hepatomas were observed, but the results were inconclusive.[16, 17] The concentration of 1,2-DCP administered in this study was over 100,000 times higher than the concentration measured in the high school staff lounge during the 1998 sampling event.

On the basis of available toxicological information, it is unlikely that short- or long-term exposures to 1,2-DCP at levels detected in the high school staff lounge during the 1998 sampling event would result in chronic health problems. 1,2-DCP air monitoring results, sampling locations, and health comparison values are presented in Table A10.

D. Soil Gas

______*D1. Nature and extent of contamination*

VOCs were detected in subsurface soil gas, both on and off the Cenex site. The highest on-site VOC concentrations were detected between the former fumigant tank area and rinse pad. Lower concentrations were detected off-site, to the south and southeast, underneath the high school property, and underneath the Desert Electric property. The highest concentration of 1,2-DCP detected in subsurface soil gas underneath the high school property was 5.9 mg/m^3. The highest concentration of 1,2-DCP in subsurface soil gas underneath the Cenex site was 3,010 mg/m^3 (651 ppm). Chlorobenzene, chloroform, 1,1-DCE, and vinyl chloride were also detected in on-site soil gas, but at considerably lower concentrations. Soil gas results are presented in Table A8.

______*D2. Pathways analysis and public health implications*

Site remediation workers are the most likely persons to come into direct contact with subsurface soil gas vapors. It is presumed they are aware of site conditions, and are taking the appropriate precautions to protect themselves from potential exposures. To mitigate further VOC contamination of the groundwater, and to reduce or eliminate the possibility of migration into the air, Cenex employed a soil vapor extraction system in fall 1998. The system continues to remove VOCs from site soil. 1,2-dichloropropane has not been detected in air samples collected after the system's carbon units, indicating that all of the VOCs being removed from the soil are being contained within the system's carbon media, and not being released into the air.

E. Soil

______*E1. Nature and extent of contamination*

Most of the contaminated soil was excavated and removed from the site during the summer of 1997. Residual contaminant levels on the site are low, and do not pose a health threat. A 6-inch gravel layer was placed over the site, further reducing the chance for exposure.

For this health assessment, exposures to site soil contaminants were assumed to have occurred prior to site soil remediation in 1997. The higher of either the 1993 EPA soil/sludge or 1995 Cenex soil sampling results were used in the health assessment to evaluate potential health impacts, *regardless of the depth or location of the soil samples.* Persons assumed to be exposed include Cenex employees, adult residents, and children noted to occasionally have played on ramps and walked or bicycled across the site to and from school (Cenex Supply and Marketing, Inc., personal communication, 1997). The site was fenced in 1996, which effectively eliminated the potential for further residential direct contact exposures. Pre-remediated and post-remediated soil contaminant concentrations are presented in Tables A1 through A4, and A6 through A8.

Six herbicide/pesticide compounds (trifluralin, vernolate, ethalfluralin, disulfoton, atrazine, and alachlor), one insecticide (chlorpyrifos), and four metals (chromium, beryllium, cadmium, and thallium) exceeded health comparison values in site soil, and were further evaluated in the health assessment. These 11 contaminants are discussed below relative to pathways of exposure and public health implications.

E2. Pathways analysis and public health implications

Trifluralin

Trifluralin is a selective preemergent herbicide used to control annual grasses and some broadleaf annual weeds. Trifluralin was detected in soil during both the 1993 EPA and 1995 Cenex sampling events. The highest concentration (349 mg/kg) was from a subsurface sample collected underneath the former rinsate pond (EPA sample #RPS4). The highest concentration of trifluralin detected during the June 1997 (post-remediation) sampling event was 0.298 mg/kg, well below health comparison values.

Noncancer toxicity

Acute-duration laboratory animal tests have demonstrated trifluralin to have low to moderate acute toxicity by oral or dermal exposure, and moderate acute toxicity by inhalation.[17, 18] EPA has not established an RfC for trifluralin. Exposure to high doses of trifluralin are associated with increases in kidney, bladder, and thyroid tumors. Dogs chronically exposed to trifluralin in their diet showed decreased weight gain, changes in hematological parameters, and increased liver weight.[17] Skeletal abnormalities were observed in the offspring of mice exposed via gavage (experimentally introducing trifluralin into the stomach). The RfD for trifluralin is based on increased liver weights and an increase in methemoglobinemia in dogs.[17] *The estimated child and adult exposure doses were well below the chronic oral RfD, suggesting that noncancer health effects are unlikely.*

Cancer toxicity

EPA classifies trifluralin as a Group C (possible human) carcinogen. No studies were located in the scientific literature regarding the carcinogenicity of trifluralin in humans. Classification is based on the induction of urinary tract tumors (renal pelvis carcinomas and urinary bladder papillomas) and thyroid tumors (adenomas/carcinomas combined) in one rat study.[17] Trifluralin did not produce statistically significant increases in tumors in other studies.[17] For this health assessment, the estimated increased cancer risk for children and adults assumed to be exposed to trifluralin in soil was slight; approximately one additional cancer in a population of 1 million persons exposed. Because of the highly conservative exposure assumptions (i.e., that exposures occurred over many years to the highest detected concentration), the actual risk is likely even lower.

Cancer Risk

Cancer risk estimates do not reach zero no matter how low the level of exposure to a carcinogen. Terms used to describe this risk are defined below as the number of additional cancers expected in a lifetime:

Term		# of Additional Cancers
moderate	is approximately equal to	1 in 1,000
low	is approximately equal to	1 in 10,000
very low	is approximately equal to	1 in 100,000
slight	is approximately equal to	1 in 1,000,000

Ethalfluralin

Ethalfluralin is a selective preemergent herbicide, structurally similar to trifluralin. Like trifluralin, it is a dinitroaniline compound. Ethalfluralin is readily degraded in soil, both by microorganisms and by photodecomposition. Ethalfluralin was detected in site soil during both the 1993 EPA and 1995 Cenex sampling events. The highest concentration (1,530 mg/kg) was from a subsurface sample collected from the excavation on the north side of the former rinsate pond (EPA sample #RPS3). The highest concentration of ethalfluralin detected during the June 1997 sampling event, after soil removal, was 0.363 mg/kg, well below health comparison values.

Noncancer toxicity

Although no health comparison values exist for ethalfluralin, toxicological references suggest that, because of its chemical similarity to trifluralin, exposure would be expected to result in similar health effects. Limited rat studies have demonstrated several structurally similar urinary metabolites for these two compounds.[17] Because of this similarity, the cancer slope factor established for trifluralin was also used in this health assessment to assess the cancer risk for exposure to ethalfluralin. Likewise, the RfD established for trifluralin was used to assess the potential for noncancer health effects from exposure to ethalfluralin. EPA has not established an RfC for ethalfluralin.

The estimated exposure doses were below the oral RfD, and were well below doses which caused health effects in laboratory animals, suggesting that noncancer health effects are unlikely.

Cancer toxicity

Chronic mouse and rat-feeding studies indicate ethalfluralin has a low potential for carcinogenicity.[18] One study demonstrated an increase in benign mammary tumors in female rats after high doses were administered over a 2-year period.[18, 19] In addition, ethalfluralin produced a common urinary metabolite in rats (Dow specimen label for ethalfluralin, Pesticide Dictionary). The estimated increased cancer risk for children and adults assumed to be exposed to ethalfluralin in soil at the Cenex site was slight; approximately two additional cancers in a population of 1 million persons exposed. Because of the highly conservative exposure assumptions (ingestion of the highest detected concentration over many years), the actual risk is likely much lower. For example, the highest detected concentration of ethalfluralin in site *surface* soil, where exposures would be more likely to occur, was only one-third the maximum detected concentration evaluated in this health assessment (from a subsurface sample).

Disulfoton

Disulfoton is an organophosphate pesticide used to control a variety of harmful pests that attack many field and vegetable crops. Disulfoton binds moderately well to soil and typically does not readily migrate deep into the soil.[17, 20, 21] Disulfoton was detected in soil during both the 1993 EPA and 1997 Cenex sampling events. The highest concentration (146 mg/kg) was from a subsurface sample collected in the excavation on the north side of the former rinsate pond (EPA sample #RPS2). Disulfoton was not detected after the June 1997 soil removal.

Noncancer toxicity

Health effects from exposure to high levels of disulfoton (much higher than levels detected at the Cenex site) include effects on the nervous system, narrowing of the pupils, vomiting, diarrhea, drooling, difficulty in breathing, tremors, convulsions, and even death.[20, 21] The chronic oral MRL for disulfoton is based on decreased cholinesterase activity observed in female rats after a chronic feeding study.[17] Although estimated adult and child exposure doses exceeded the chronic oral MRL and RfD by a factor of three to five, they were 350 to 450 times lower than the lowest dose that produced adverse health effects in the study. Disulfoton levels detected in surface soil, where exposures would have been more likely to occur, were much lower (from 3.4 mg/kg to 8.8 mg/kg). Estimated doses from exposure to disulfoton levels in surface soil were below the oral RfD, suggesting that adverse noncancer health effects were unlikely. EPA has not established an RfC for disulfoton.

Cancer toxicity

No studies were located in the scientific literature regarding cancer in humans after oral exposure to disulfoton.[17, 20] There was no evidence of carcinogenicity in Beagle dogs fed disulfoton for two years at doses many times higher than were estimated for children or adults assumed to be exposed at the Cenex site.[20] As a result, cancer effects would not be expected.

Vernolate

Vernolate is a thiocarbamate compound used as a selective soil-incorporated herbicide to control broadleaf and grassy weeds. Vernolate is registered in the United States for use on corn.[17, 22, 23] Vernolate was detected in soil during both the 1993 EPA and 1995 Cenex sampling events. The highest concentration (112 mg/kg) was from a subsurface sample in the excavation on the north side of the former rinsate pond (EPA sample #RPS3). The highest concentration of vernolate detected during the June 1997 sampling event, after soil remediation, was 0.295 mg/kg, well below the health comparison value.

Noncancer toxicity

The RfD established for vernolate is based on a two-generation reproduction rat study which showed a statistically significant depression in the mean body weight of rats fed vernolate in their diet.[17, 22] The estimated doses were 10 times less than the chronic oral RfD, suggesting that noncancer health effects are unlikely. EPA has not established an RfC for vernolate.

Cancer toxicity

No studies were located in the scientific literature regarding human carcinogenicity from exposure to vernolate. In a 24-month mouse study, no oncogenic/carcinogenic effects were observed at vernolate concentrations as high as 100 mg/kg/day (thousands of times higher than estimated Cenex site exposures).[17, 23] Based on available information, cancer would not be expected for persons assumed to be exposed to the detected concentration of vernolate at the site.

Chlorpyrifos

Chlorpyrifos is an organophosphorus insecticide that has been widely used in the home and on farms. In the home, it has been used to control cockroaches, fleas, and termites. It has also been an active ingredient in some flea and tick collars. On farms, it is used to control ticks on cattle, and as a spray to control crop pests.[24] In 1997, chlorpyrifos was voluntarily withdrawn from most indoor and pet uses by the manufacturer, DowElanco.

Chlorpyrifos adheres tightly to soil particles. Volatilization is the major route in which chlorpyrifos disperses after it is applied. Once in the environment, chlorpyrifos is broken down by sunlight, bacteria, or other chemical processes.[24]

Chlorpyrifos was detected in soil during the 1993 EPA sampling event. The highest concentration (162 mg/kg) was from a surface sample collected between the former rinse pad and old Telone plant (EPA sample # SS2).

Noncancer toxicity

Short-term exposure to moderate levels of chlorpyrifos can cause dizziness, fatigue, runny nose or eyes, salivation, nausea, intestinal discomfort, sweating, and changes in heart rate. Short-term exposure to much higher levels of chlorpyrifos may cause paralysis, seizures, loss of consciousness, and death. Short-term exposure at high concentrations may cause muscle weakness weeks after the original symptoms have disappeared. Other effects include changes in behavior or sleeping patterns, mood changes, and effects on the nerves and/or muscles in the limbs.[24] The EPA has not established an RfC for chlorpyrifos.

The MRL is based on acetylcholinesterase inhibition in rats. Estimated doses in this health assessment were well below the MRL and chronic oral RfD, suggesting that noncancer health effects are unlikely.

Cancer toxicity

No information was located in the scientific literature regarding carcinogenic effects of chlorpyrifos in humans following oral exposure. Chronic-duration exposure studies have shown no carcinogenicity in animals.[24] The EPA has not classified chlorpyrifos for carcinogenicity (Class D).

Atrazine

Atrazine is an herbicide that selectively controls broadleaf (dicot) weeds, such as pigweed, cocklebur, velvetleaf and certain grass weeds in fields of corn and sorghum.

Atrazine was detected in soil during the 1993 EPA sampling event and 1995 Cenex sampling event. The highest concentration in soil (8.51 mg/kg) was from a surface sample collected by Cenex.

Noncancer toxicity

The RfD for atrazine is based on decreased body weight gain in rats chronically fed atrazine in their diet. The estimated child and adult exposure doses were well below the RfD, suggesting that noncancer health effects would not be expected.

Cancer toxicity

Since there is currently no oral cancer slope factor for atrazine, the former slope factor was used to estimate cancer risk. Using the former slope factor resulted in a slight estimated increased cancer risk for persons assumed to be exposed chronically to the single highest detection of atrazine in site soil.

Alachlor

Alachlor is an aniline herbicide used to control annual grasses and broadleaf weeds in field corn, soybeans, and peanuts. The highest detected concentration (19.8 mg/kg) was from a surface sample collected between the former rinse pad and old Telone plant (EPA sample # SS2).

Noncancer toxicity

The RfD is based on hemosiderosis observed in the kidney and spleen of beagle dogs and hemolytic anemia during a 1-year feeding study. Estimated doses for this health assessment were well below the RfD, indicating that noncancer health effects would not be expected.

Cancer toxicity

Although there is currently no oral cancer slope factor listed for alachlor, a previous slope factor for alachlor was located in EPA's 1997 Update Health Effects Assessment Summary Table (HEAST). EPA Region 3 also lists a health comparison value for alachlor (October 2000 RBC Table). Using the former slope factor, estimated past exposures to the highest detected concentration of alachlor were estimated to result in a slight additional increased cancer risk.

Cadmium

Cadmium is an element that occurs naturally in the earth's crust. It is one of many elements that are commonly called "heavy metals." Most cadmium in the United States is extracted as a by-product during the production of other metals such as zinc, lead, or copper. Cadmium is used in batteries, pigments, metal coatings, plastics, and some metal alloys.

Long-term exposure to lower levels of cadmium can lead to a buildup of cadmium in the kidney and possible kidney disease. Other potential long-term effects are lung damage and fragile bones. Skin contact with lower levels of cadmium is not known to affect the health of people or animals.[25]

The highest concentration of cadmium (25.2 mg/kg) was from EPA soil sample # RPS4, collected at the former rinsate pond. This concentration exceeded the 0.5 mg/kg mean background concentration of cadmium for the Yakima Basin region.

Noncancer toxicity

The EPA has established separate oral RfDs for cadmium in food and water. For this health assessment, the oral RfD for food was used to assess the potential for noncancer health effects, and is based on kidney effects in humans. The estimated doses were well below the oral RfD, suggesting that noncancer health effects are unlikely. The EPA has not established an RfC for cadmium.

Cancer toxicity

The EPA classifies cadmium as a probable human carcinogen by the inhalation route. Neither human nor animal studies provide conclusive evidence to determine whether or not cadmium is carcinogenic by the oral route. A few studies of cancer rates among humans orally exposed to cadmium have been performed. However, there is little evidence of an association between oral exposure to cadmium and increased cancer rates in humans.[25] In a 1992 rat study, oral exposure to very high doses of cadmium was associated with tumors of the prostate, testes, and hematopoietic (blood-forming) system.[25] The estimated child and adult cadmium exposure doses were well below the cancer effect level (CEL) derived from the 1992 rat study. As a result, cancer effects would not be expected from exposure to even the highest level of cadmium detected.

Chromium

Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms. Trivalent chromium in small amounts is an essential nutrient.[26] For this health assessment, it was conservatively assumed that 100% of the detected chromium was in the more toxic hexavalent form.

Chromium was detected in soil samples collected during both the 1993 and 1997 sampling events. One sample (sample # RPS4), collected at the former rinsate pond, slightly exceeded a noncancer comparison value.

Noncancer toxicity

Although ingesting small amounts of hexavalent chromium at low concentrations is not believed to be harmful, ingestion of large amounts of hexavalent chromium has caused stomach upsets, ulcers, convulsions, kidney and liver damage, and even death.[26] There are no long-term studies of ingested hexavalent chromium. The respiratory system and the skin are the primary target organs for exposure to chromium and its compounds. Workers exposed to hexavalent chromium have developed skin ulcers and allergic reactions consisting of severe redness and swelling of the skin.[26] The oral RfD for hexavalent chromium is based on systemic effects in rats exposed to hexavalent chromium in drinking water over a 1-year period.[17, 26] The oral RfD for trivalent chromium also is based on systemic effects in rats. The estimated safe and adequate daily dietary intake for chromium of 50–200 µg/day has been established by the National Research Council, corresponding to 0.71–2.9 µg/kg/day for an adult.[17] ATSDR has adopted the upper range of the estimated safe and adequate daily dietary intake of 200 µg/day as an interim guidance for oral exposure to hexavalent and trivalent chromium.[26]

The child and adult estimated exposure doses were well below the oral RfDs established for hexavalent and trivalent chromium, suggesting that noncancer health effects are unlikely.

Cancer toxicity

EPA classifies hexavalent chromium as a Class-A (human) carcinogen by the inhalation route of exposure, based upon both animal studies and studies of worker exposures in the chrome-plating industry. Long-term exposure to chromium has been associated with lung cancer in workers. Animal studies have not shown hexavalent chromium to be carcinogenic by the oral route of exposure.[17, 26] No other studies were located in the scientific literature that suggests hexavalent chromium is carcinogenic by the oral route of exposure.

The levels of chromium detected at the site were not at levels expected to result in the development of cancer.

Beryllium

Pure beryllium is a hard, grayish metal. In nature, beryllium can be found in compounds in mineral rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined, and the beryllium purified for use in electrical parts, machine parts, ceramics, aircraft parts, nuclear weapons, and mirrors. The greatest potential for exposure to beryllium is from occupational exposure (primarily in the form of beryllium oxide). Exposure to high levels of beryllium in air can cause lung damage and a disease that resembles pneumonia. Long-term exposure to beryllium or beryllium oxide at much lower levels has been reported to cause chronic beryllium disease in sensitive individuals, characterized by shortness of breath, scarring of the lungs, and berylliosis. In addition, a skin allergy has been shown to develop when soluble beryllium compounds come in contact with the skin of sensitized individuals. Animal studies have shown that only small amounts of beryllium are absorbed after ingestion of beryllium or its compounds.[27]

Beryllium was detected in soil samples collected during both the 1993 and 1997 sampling events. A single sample (EPA sample # RPS4), collected at the former rinsate pond in 1993, slightly exceeded a health comparison value. *All detected concentrations, however, were within the 0.39 mg/kg to 2.79 mg/kg range of natural background beryllium concentrations for the Yakima Basin.*[28]

Noncancer toxicity

An oral RfD has been established by EPA and is based on a 1976 study of exposure to beryllium that resulted in small intestinal lesions in male and female dogs. Adult and child estimated exposure doses were well below the chronic oral RfD, suggesting that noncancer health effects are unlikely.

Cancer toxicity

No studies were located in the scientific literature regarding cancer in humans after oral exposure to beryllium or its compounds. Chronic oral ingestion studies did not result in increased incidences of tumors in rodents.[27] The EPA recently reclassified beryllium from a B2 (probable human carcinogen, sufficient evidence in animals, and inadequate or no evidence in humans) to a B1 (probable human carcinogen, limited human data are available) carcinogen *on the basis of the inhalation route of exposure.*[17] Because there is currently no oral slope factor listed, the former oral slope factor was used.

The estimated increased child and adult cancer risk from exposure to the highest detected concentration of beryllium in soil (1.39 mg/kg) is slight; approximately one additional cancer in a population of 1 million persons exposed. This slight increased cancer risk can be attributed entirely to natural background beryllium concentrations in the native soil.

Thallium

Thallium is used mostly in manufacturing electronic devices, switches, and closures, primarily for the semiconductor industry. It also has limited use in the manufacture of special glass and for certain medical procedures.

The highest concentration of thallium detected at the site was 6.7 mg/kg from EPA sample # RPS4, collected at the former rinsate pond. The concentration was determined by the lab to be above the instrument detection limit, but below the minimum quantitation limit.

Noncancer toxicity

The single highest concentration of thallium detected slightly exceeded the MTCA method B noncarcinogenic soil clean-up level of 5.6 mg/kg. The estimated exposure dose, assuming chronic exposure to the highest detected thallium concentration, was below the oral RfD for the five thallium compounds listed in EPA's Integrated Risk Information System (IRIS). As a result, noncancer health effects would not be expected.

Cancer toxicity

The Department of Health and Human Services, the International Agency for Research on Cancer, and the EPA have not classified thallium as to its human carcinogenicity. No studies are available in people or animals on the carcinogenic effects of breathing, ingesting, or touching thallium.

Multiple Chemical Exposure

A person can be exposed by more than one pathway and to more than one chemical. Exposure to multiple pathways occurs if a contaminant is present in more than one medium (i.e., air, soil, surface water, groundwater, and sediment). For example, the dose of a contaminant received from drinking water might be combined with the dose received from contact with that same contaminant in soil.

For many chemicals, much information is available on how the individual chemical produces effects. It is much more difficult, however, to assess exposure to multiple chemicals. The vast number of chemicals in the environment make it impossible to measure all of the possible interactions between these chemicals. The potential exists for these chemicals to interact in the body and increase or decrease the potential for adverse health effects. Individual cancer risk estimates can be added since they are measures of probability. When estimating noncancer risk, however, similarities must exist between the chemicals if the doses are to be added. Groups of chemicals that have similar toxic effects can be added, such as volatile organic compounds (VOCs) which cause liver toxicity. Polycyclic aromatic hydrocarbons (PAHs) are another group of chemicals that can be assessed as one combined dose based on similarities in chemical structure and metabolites. Although some chemicals can interact to cause a toxic effect that is greater than the added effect, there is little evidence demonstrating this at concentrations commonly found in the environment.

Tables A13 and A14 summarize estimated total cancer and noncancer risks for adults and for children, assuming concurrent exposure to the highest detected concentrations of all 11 contaminants of concern detected in site soil. *The total estimated increased cancer risk was low; approximately five to seven additional cancers in a population of 1 million persons exposed.* Individual noncancer risk estimates (hazard quotients) were conservatively added to assess the likelihood of adverse noncancer health effects. Although the total noncancer risk estimates slightly exceeded a hazard quotient of one (suggesting the possibility of noncancerous health effects), upon careful review of the relevant toxicity studies, adverse health effects would not be expected. The combined exposure doses were still well below the toxic effect levels observed in the toxicity studies. In addition, disulfoton was the only contaminant responsible for the hazard quotient exceedence, and it was detected in a subsurface soil sample, where exposure is unlikely to occur.

Child Health/Developmental and Reproductive Effects

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children deserve special emphasis with regard to exposures to environmental contaminants. Infants, young children, and the unborn might be at greater risk than adults from exposure to particular contaminants. Exposure during key periods of growth and development might lead to malformation of organs (teratogenesis), disruption of function, and even premature death. In certain instances, maternal exposure, via the placenta, could adversely effect the fetus. After birth, children might receive greater exposures to environmental contaminants than adults. Children are often more likely to be exposed to contaminants from playing outdoors, ingesting food that has come into contact with hazardous substances, or breathing soil and dust. Pound-for-pound of body weight, children drink more water, eat more food, and breathe more air than adults. For example, in the United States, children in the first 6 months of life drink 7 times as much water per pound as the average adult.[29] The implication for environmental health is that, by virtue of children's lower body weight, given the same exposures, they can receive significantly higher relative contaminant doses than adults.

The scientific literature was reviewed to evaluate the likelihood of adverse reproductive or developmental health effects as a result of exposure to the site-related contaminants of concern. Estimated exposures *were well below levels observed to cause adverse reproductive or developmental health effects for all of the contaminants evaluated.*

Health Outcome Data Evaluation for Quincy

Health outcome data are investigated when the concentrations of the chemicals of concern are at levels where we might expect to find adverse health effects. WDOH evaluated all of the environmental sampling data collected to date at the Cenex site to assess the likelihood that persons living near the site would experience higher rates of disease. In high-dose animal studies, some of the contaminants of concern have been associated with specific cancers, such as renal pelvis cancer, thyroid tumors, and bladder cancer (see the Discussion section). However, under very conservative exposure scenarios (assuming exposure to the highest detected concentrations of all of the contaminants of concern at the site over many years), the *total* estimated increased lifetime cancer risk for children and adults was low; less than one additional cancer in a population of 100,000 persons exposed for many years. Using a more realistic exposure scenario (i.e., using surface soil contaminant concentrations instead of subsurface soil contaminant concentrations, where the levels were usually lower, and shorter, more realistic exposure durations), the potential for developing cancer is substantially less. There was no evidence that exposure to the chemicals at this site would result in other chronic health conditions. Given the very low likelihood that anyone around the site would have experienced any long-term lasting adverse health outcomes, and the relatively small number of people potentially exposed to the site, it was not feasible to accurately assess any health impacts for this immediate area by using existing data sources such as the Washington State Cancer Registry. However, some residents have expressed strong concerns about cancer. For example, at a WDOH-sponsored Open House in Quincy in 1997, a number of residents were concerned that the population living near the site had experienced higher rates of cancer of the brain, breast, lymph, throat, colon, liver, kidney, bladder, lung and thyroid. Other noncancer health concerns were expressed by some area residents, and were addressed by WDOH in the Community Health Concerns section of the health assessment.

In response to the cancer concerns, data from the Washington State Cancer Registry were evaluated to determine if there were more cases of cancer among Quincy area residents (i.e., ZIP code 98848) than would be expected. To calculate the number of cases of each type of cancer that would be expected to occur in Quincy if the rate in Quincy was the same as the state as a whole, we calculated statewide cancer rates for each type of cancer within specific age groups for each gender. We then multiplied these rates by the number of people in Quincy in each of these gender and age groups. Finally, we added the results for all the gender and age groups together to obtain a total number of expected cases of that cancer. This analysis was carried out for the 24 major sites of cancer using all seven years of available data (i.e., 1992-1998). The cancer sites included: bladder, brain, breast (female), cervix, colorectal, endometrium, esophagus, Kaposi's sarcoma, kidney and renal pelvis, larynx, leukemia, liver, Hodgkin's lymphoma, Non-Hodgkin's lymphoma, lung, melanoma of the skin, multiple myeloma, oral cavity and pharynx, ovary, pancreas, prostate, stomach, testes, and thyroid. In addition, we examined cancers of unknown primary site (i.e., cancers diagnosed at an advanced stage for which it was impossible to determine the site where the cancer began), all other cancers, and all cancers combined.

In a small community such as Quincy, the number of cancer cases from a specific site will be relatively small and will vary considerably from year to year. Even when several years of information are used, the observed number of cases will rarely be exactly equal to the expected number of cases. For some cancer sites there will be more cases than expected, for other sites there will be fewer cases than expected. These differences are sometimes due to the random variation in the number of cases seen each year. However, in other instances, the difference might indicate that there actually is a higher or lower rate of new cancer cases in the community than would be expected.

To determine whether the difference between the observed and expected number of cancer cases was due to random variation, we conducted statistical tests and computed p-values. The statistical test assesses how likely it is to have the observed number of cancer cases if the actual cancer rate in Quincy was the same as the state as a whole. The resulting p-value is an estimate of the probability of having the observed number of cases, or a number of cases which is even further from the expected number of cases based on the overall state average. If the p-value is

0.05 or less, we say the comparison is statistically significant, meaning there is evidence of a difference between the incidence of cancer in Quincy and the state average. If the p-value is larger than 0.05, we say there is no evidence of a difference in the cancer incidence.

By chance alone, we expect to see a p-value of 0.05 or less in about 1 out of every 20 statistical tests. Therefore, when we conduct many statistical tests, as in this analysis, we expect to see some "significant" p-values even if there is no real difference between cancer incidence in Quincy and the rest of the state. The smaller a p-value is, the stronger the evidence that there is a real difference between Quincy and the state average.

Overall, there were fewer total reported cases of cancer in Quincy during the 1992 to 1998 time period than would be expected in a community in Washington of the same size and age structure (Table 1). There were a higher number of cancers of "unknown primary site." These are cancers diagnosed at an advanced stage for which it was impossible to determine the site where the cancer began. Since these were different types of cancer, it is very unlikely that they would have had a common underlying cause. Many other cancer sites had fewer cases than expected, including Kaposi's sarcoma, liver, lung and bronchus, melanoma of the skin, and testes. Cancer rates for the other sites did not appear to be different than would be expected on the basis of Washington State rates.

This analysis used data for all residents living in the 98848 ZIP code, and, as such, the results do not specifically apply to just those residents living near the Cenex facility. Including residents who were not exposed to site contaminants can affect the analysis in two ways. First, the inclusion of unexposed persons in the study population might obscure an otherwise measurable cancer increase in the exposed population. However, measuring cancer in only the population who were potentially exposed (i.e., those living very close to the facility) greatly reduces the number of people in the analysis, making it very difficult to accurately estimate the expected number of cases or to interpret the comparison of the observed cases to the expected number. For example, in very small areas, it is difficult to accurately estimate the population for non-census years, and even one case of cancer may represent a statistically significant increase. Secondly, when people who do not live in the area of potential exposure have cancer risk factors not found in the exposed population, then an increase in cancer may be observed that is not related to exposure to the site. Given the low likelihood that anyone exposed to the site would have experienced any adverse health outcomes, and the problems in assessing cancer risk in situations where the potentially exposed population is very small, we do not feel that it is useful to conduct these analyses for an area smaller than the Quincy ZIP code.

Table 1: Cancer incidences reported and expected for the Quincy area (1992–1998)

Cancer Incidence for Quincy, WA (Zip Code 98848)								Observed # of Cases	Expected # of Cases	p-values*
Primary Site Category	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1992-98**	**1992-1998**	**1992-98**
All Cancers	29	39	29	31	35	35	35	233	275.5	0.01
Bladder	1	1	0	2	1	0	2	7	11.8	0.20
Brain	0	0	0	1	0	1	0	2	3.7	0.57
Breast (female)	5	7	2	8	4	8	10	44	42.5	0.74
Cervix	0	0	0	0	1	1	1	3	2.2	0.36
Colorectal	4	4	3	1	5	1	1	19	28.2	0.09
Endometrium	1	0	2	0	0	0	0	3	7.0	0.16
Esophagus	1	0	1	0	1	0	1	4	2.7	0.27
Kaposi's Sarcoma	0	0	0	0	0	0	0	0	1.0	0.74
Hodgkins Lymphoma	0	0	0	1	0	0	0	1	1.7	0.99
Kidney and Renal Pelvis	1	1	0	2	0	3	3	10	6.0	0.09
Larynx	0	1	0	0	0	0	0	1	2.4	0.62
Leukemia	1	1	1	0	1	1	0	5	6.8	0.65
Liver	0	0	0	0	0	0	0	0	1.7	0.37
Lung and Bronchus	4	4	5	3	4	1	5	26	38.1	0.05
Melanoma of the Skin	0	4	0	1	1	1	1	8	15.3	0.06
Multiple Myeloma	0	1	0	0	1	1	0	3	3.0	1.0
Non-Hodgkins Lymphoma	0	1	1	1	3	4	1	11	10.3	0.68
Oral Cavity and Pharynx	1	0	1	1	0	0	0	3	6.5	0.22
Ovary	0	2	0	0	0	1	0	3	4.9	0.56
Pancreas	0	1	0	1	1	1	0	4	5.4	0.75
Prostate	6	8	8	7	6	7	4	46	46.3	0.96
Stomach	1	0	1	0	0	1	1	4	3.6	0.59
Testes	0	0	0	0	0	0	0	0	2.2	0.22
Thyroid	0	0	0	0	1	0	1	2	3.6	0.61
Unknown Primary Site	2	2	3	1	2	1	1	12	5.6	0.01
All Other Sites	1	1	1	1	3	2	3	12	15.2	0.50

* Two-sided p-values

Community Health Concerns

An Open House was hosted by the Washington State Department of Health (WDOH) on April 23, 1997, to gather community health concerns related to the site. WDOH received comments from approximately 20 residents, including four whose primary language was Spanish. A Spanish-speaking interpreter documented concerns from those residents. Several residents attended the session, but did not comment. The following health concerns were heard:

1. Resident expressed concern about asthma. The resident also knows of three or four children with brain cancer and requested a door-to-door health survey.

A number of causative agents are known or suspected to trigger asthma, although the specific reasons can vary from person to person. Common triggers include infections, lung irritants, inherited factors, allergens, sinusitus, cigarette smoke, cold weather, and occupational and environmental irritants. Although exposures to some environmental contaminants might trigger a preexisting asthma condition, WDOH found nothing in the scientific literature that suggests exposure to the detected concentrations of site contaminants, in and of themselves, would *cause* asthma.

Brain cancers can have both environmental and nonenvironmental etiologies (causes). There is evidence to suggest a link between adult workers exposed to chemicals used in certain industries (vinyl, rubber production, oil refining, and chemical manufacturing), and an increased risk of developing brain cancer. Considerably less information exists about the causes of childhood brain cancers, particularly from environmental exposures. Some studies have suggested an association between increased incidences of certain brain cancers and exposure to pesticides by pesticide applicators, and in children living in agricultural areas.[30, 31] After careful evaluation of the potential health effects from past exposure to Cenex site contaminants, brain cancer would not be expected. WDOH also studied the Washington State Cancer Registry to observe whether there was an increase in the number of brain cancers reported for the Quincy area compared to the number expected. Review of those data indicate that the number of brain cancers reported for the Quincy area were within the range expected for this time period (see Table 1).

On the basis of its evaluation of all available site-specific environmental and community health outcome data, WDOH determined that the site posed a low health risk and is not recommending a door-to-door health survey. At the request of one area resident, WDOH provided an application form for a health study shortly after the April 1997 WDOH-sponsored Open House. To date, ATSDR has no record of having received such an application.

2. A resident living on a farm indicated that aerial pesticide spraying occurs on fields surrounding his home, and is concerned about their cumulative effects on health. The resident had breast cancer and surgery in 1990. The resident's daughter and son-in-law also live on the property. The resident's daughter's baby was born with Rubinstein-Taybi Syndrome. The resident also stated that their homes are ½ mile from the city's waste

disposal area. The resident is also concerned that waste and urine from a feedlot might be contaminating the groundwater.

The primary purpose of this health assessment was to evaluate the potential health effects from exposure to *site-specific* contaminants. WDOH concluded that the site posed a low health risk due to previously elevated levels of some herbicides and pesticides in soil at the Cenex site. The risk was for persons assumed to be exposed through ingestion, skin contact, and inhalation to the most contaminated soil over many years. The site does not currently pose a health hazard.

The cause of Rubinstein-Taybi Syndrome (RTS) is unknown.[32] Although some type of genetic origin is possible, no definite genetic pattern has been identified. There have been no consistent chemical or other environmental exposures reported during pregnancy for children born with RTS.

Exposures to pesticides from aerial application have the potential to pose a health risk, depending on the duration, type, and concentration of pesticides one is exposed to. WDOH was not provided specific information on the aerial pesticide exposures in question, and did not evaluate the associated health implications. The purpose of this health assessment was to evaluate potential health risks associated with exposure to contaminants from the Cenex facility, not to evaluate health risks related to areawide aerial pesticide spraying. For additional information concerning pesticide poisoning issues, contact Lynden Baum, manager of the WDOH Pesticide Investigation and Surveillance Unit (360-236-3361, or toll-free at 1-888-586-9427) can be contacted. The Washington State Department of Agriculture, Pesticide Management Compliance Unit, Yakima Branch (509-225-2640) and the Washington State Department of Labor and Industries Compliance Unit (509-886-6505) can be contacted for issues relating to pesticide application regulations and worker health and safety issues, respectively.

If the resident suspects the nearby feedlot or city waste disposal area are impacting the groundwater, WDOH recommends contacting the Grant County Health District to request an inspection. If residential wells are at risk, follow-up testing of the wells should be considered. WDOH is available to evaluate the results of any such testing.

3. Resident is concerned about the possibility of ambient chemicals in the air causing lung disease. The resident also asked whether there would be enough time to move people away from the site if there was a major problem. The resident asked about the types of chemicals in the ground. Resident is also concerned that the schools are too close to the surrounding chemical plants and if the plants can be moved away from the schools.

Lung disease can be caused by many factors (see WDOH response to question # 1, above). Ambient air sampling at the Cenex site, prior to installation of the soil vapor extraction (SVE) system, was limited. Only 1,2-dichloropropane and a small number of other volatile organic compounds (VOCs) of concern that were present in Cenex site soil gas were tested. Air sampling conducted after the SVE system became operational has not detected 1,2-dichloropropane. Potential contribution of airborne contaminants originating from other facilities was not part of this health assessment. If additional ambient air sampling is conducted at the site, WDOH is available to evaluate the results. For the reasons described previously, WDOH recommended follow-up air sampling at the high school. This additional air sampling was done in August 2000, and no site-related contaminants, or other contaminants at levels of health concern, were detected. A follow-up indoor air sampling investigation was conducted inside the high school in fall 2001, the results of which also will be evaluated by WDOH.

In general, it is prudent to zone public institutions, such as schools and residences, away from industrial areas. WDOH recommends contacting the local or state agency responsible for emergency response in your area (most likely the Fire Department or Department of Ecology) regarding inquiries about the readiness of adjacent facilities to respond to accidental releases. Staff with the Department of Ecology’s Hazardous Waste and Toxics Reduction Program routinely inspect hazardous waste generation and storage facilities. They can also be contacted for additional information, or to request a facility inspection.

The types and concentrations of contaminants detected in the ground, and the respective health comparison values, are listed in Appendix A of this report.

4. A resident stated that his wife and daughter have a recurring cough and that one of his daughters has asthma. Their young son has behavior problems. The resident wants to know what materials were dumped at the site, at what concentrations, and from what sources. Resident is concerned that Cenex built the site poorly and illegally and its record keeping and materials tracking was poor.

Based on the limited information provided by the commenter, WDOH cannot assess the reasons for the recurring coughs or behavioral problems. WDOH recommends asking your primary care physician about these conditions. The primary contaminants of concern released at the Cenex site were fumigants (primarily Telone), solvents, and pesticide/herbicide compounds. The reader can refer to the Background section of this report for a brief description of activities at the site that resulted in the contamination. The types and concentrations of contaminants detected are located in the data tables in Appendix A. The References section lists the primary documents available regarding the site investigation and cleanup, which are available for public review.

Cenex has acknowledged that past site activities have resulted in the release of hazardous chemicals into the environment. Cenex, with Ecology oversight, continues to evaluate and clean up the site. Guy Gregory, site manager with the Department of Ecology (509-456-6387), can be contacted for additional information about Cenex’s past practices and record keeping.

5. Resident used to live near the Cenex site, has no health problems, and thought the announcement was alarming. Resident has no concerns and has seen no health effects.

Comment has been noted.

6. Resident has lived in Quincy for 30 years and used to live upriver from the Hanford reservation. Her husband died of cancer and a friend had lymph and kidney cancer. She wants to know if there is a connection with those cancers and site contaminants. Resident wants to know if there is a large number of cancers in the area.

After careful review and evaluation of all available site environmental sampling data, WDOH concluded that exposure to contaminants detected at the Cenex site are unlikely to result in chronic adverse health effects. Under a very conservative exposure scenario (ingestion, inhalation, and skin contact with the most contaminated soil over many years), WDOH estimated a low increased cancer risk. The reader can refer to the Discussion and Conclusion sections of this report for a more complete analysis of the health risks.

The reader can refer to the **Health Outcome Data Evaluation for Quincy** section of this report for a summary of cancers reported for the Quincy area, compared to the number of cancers expected.

This health assessment was intended to summarize the potential health impacts from exposure to *Cenex site contaminants only*. The Department of Health's Hanford Health Information Network (HHIN) was created to provide information on the known and potential health effects of the radioactive releases from the Hanford Nuclear Reservation, located in south central Washington State. Although HHIN no longer exists, information and related links can be obtained by accessing their Web site at http://www.doh.wa.gov/hanford/. A December 2000 report summarizing the Hanford Individual Dose Assessment Project titled "Final Report" is also available from WDOH's Division of Radiation Protection.

There were a number of concerns expressed by some area residents about the possible health impacts as a result of contaminants detected at the Cenex site. This (the Community Health Concerns section) is a summary of all of the concerns, and WDOH's responses to the concerns.

7. Resident's office has been located 200 feet southeast of the site for the past 15 years. He has had sinus problems for the past 4 to 5 years and wants to know if dust exposure from the site could be the cause. The resident is also concerned about health risks of his employees, whether his property is contaminated, and is concerned that the contaminated soil piles at the site were not adequately covered.

After evaluating all available site environmental sampling data, WDOH concluded that the site posed a low health risk. WDOH noted the contaminated soil piles stockpiled on site after excavation occurred in 1997, and the fact that the cover was not 100% effective. The soil piles were taken to a licensed hazardous waste landfill in Roosevelt, Washington, in May 1997. Although concentrations of some contaminants in the excavated soil piles were elevated, they were only moderately elevated, and in and of themselves, would not be expected to result in sinus problems to exposed individuals. WDOH estimated dust exposures using an EPA particulate model. The results of this modeling effort indicated that exposure to contaminated dust generated at the site would not have posed a health hazard.

Cenex, under Ecology supervision, has investigated some properties to the south and southeast of the site, particularly to determine the nature and extent of off-site groundwater and subsurface soil gas contamination originating from the Cenex site. Groundwater contamination is the most serious environmental problem associated with the site, although there are currently no known exposures to the contaminated groundwater.

WDOH has evaluated the results of numerous soil, soil gas, groundwater, and air samples collected at various offsite locations, including the adjacent school property, Desert Electric facility, and a background site. WDOH is not recommending further off-site soil testing. However, because of community concerns, the presence of elevated levels of VOCs in the groundwater underneath the high school property, and the limited scope of the 1998 Quincy high school air sampling investigation, *WDOH recommended more comprehensive follow-up air sampling at the high school*. A more comprehensive indoor air quality study was performed at the high school in August 2000 using passive air sampling canisters (EPA Method TO-14). Method TO-14 is the standard procedure used for detecting and analyzing VOCs in air at low concentrations. No 1,2-DCP or other chemicals were detected in the samples at levels of health concern. WDOH and ATSDR recommended another round of indoor air sampling inside the high school to verify that site-related VOCs are not present at levels of health concern. This additional sampling was conducted in November 2001, the results of which will be evaluated in a separate health consultation.

8. Resident has worked at Quincy Junior High and is concerned that students and teachers are affected by the site. He wants to know what is being done and what the timeframes are for site cleanup?

Guy Gregory, site manager with the Department of Ecology, can be contacted for information concerning current site clean-up activities, and timelines for cleanup.

WDOH understands that the rinsate pond spray evaporation system, which operated at the site for a short time in the late 1980s, reportedly generated overspray which occasionally drifted onto the neighboring junior high school. Since no air sampling of the overspray was conducted during the operation of the spray system, measurement of the school exposures is not possible. However, based on the limited number of herbicide/pesticide compounds reported for the sludge (five), their generally low concentrations, the limited timeframe in which exposure would have occurred, a long-term health risk would not be expected. However, if junior high school students or staff have ongoing health concerns they feel are related to exposures from the overspray, WDOH recommends consulting with their primary care physicians. WDOH also can consult with Occupational Health physicians who specialize in the medical evaluation of environmental and occupational exposures to determine if a follow-up medical evaluation should be considered.

In early 1998, WDOH spoke with an employee of the junior high school regarding concerns he expressed about air quality there. Specific concerns included exposures to the rinsate pond overspray, the possibility of pesticides in the school’s ventilation system, and diesel fume exhaust odors. The conversation was followed up with a letter in January 1998. Included with the letter was a list of Washington State private air quality consulting firms, indoor air quality guides, an exposure history guidance form, an Environmental Health Resource Directory, an application for additional Air Quality Tools for Schools kits, and additional indoor air quality references. WDOH also referred the employee to our program's indoor air quality specialist and the Washington State Department of Labor and Industries consultative branch for additional information. WDOH has recommended follow- up ambient air sampling at the high school. Follow-up testing was conducted in August 2000, and no site-related chemicals were detected. ATSDR evaluated those results in a separate health consultation report, which was provided to the school, agency representatives, consultants, and others. Copies were also sent to the Quincy public library and city hall. Additional indoor air sampling was conducted at the high school in fall 2001.

9. Resident is concerned that little has been done, yet the site has been a known problem for a long time.

Numerous activities have occurred at the site since the early 1990s. The commenter can refer to the Background section of this report for a detailed list of those activities. Most recently (summer 2001), Cenex prepared a Remedial Action Workplan and Engineering Design documents which describe the cleanup actions, standards, and other requirements to be met at the site. Guy Gregory, the Ecology site manager, can be contacted at (509-456-6387) for information on current activities and timelines for cleanup.

10. Resident wants to know whether chemicals at the site could have caused his throat cancer. Wants to know if there is an exposure pathway and whether the site is currently safe. Resident is concerned about possible higher-than-normal cancer rates among potato plant workers near the Cenex site.

Exposure pathways were evaluated as part of the health assessment process, and are discussed in detail in the Discussion section of this report.

On the basis of the types and concentrations of contaminants detected at the site, throat cancer would not be expected to result from exposure. Since removal of the rinsate pond, fumigant tanks, and the most heavily contaminated soil, the site currently does not pose a health threat to site workers or residents.

WDOH was not provided the details of the potato plant workers' cancers, nor was WDOH provided any information about chemicals used at the potato plant to which employees might have been exposed. A detailed discussion of reported and expected cancer incidences for the Quincy area for various cancers is located in the **Health Outcome Data Evaluation** section of this report.

11. Resident expressed concerns about dust exposure to surrounding schools and residences. Resident is also concerned about whether there are adequate school evacuation plans due to the surrounding chemical plants. Resident is concerned about contaminated

mist from site-spraying operations and about contaminated sludge spread onto a farm. Resident is concerned about EDB-contaminated water at the Nielson Trailer Park water system. Resident wanted to know which lab would analyze subsequent groundwater samples, and wants a door-to-door survey.

The commenter can refer to the WDOH response to

-- comment # 7 regarding estimated dust exposures from the Cenex site. Undoubtedly, windblown dust is generated from the Cenex site *and numerous other area sources, including surrounding fields*. This health assessment focused only on potential exposures to Cenex site-related contaminants.

-- comment # 3 concerning recommendations on contacts for inquiries about evacuation/emergency response. In general, it is prudent to have appropriate notification and evacuation plans in place in the event of an unplanned hazardous chemical release(s), particularly for facilities located near at-risk populations, such as residences and schools. WDOH recommends contacting the local fire department, school administrator, and/or Grant County Health District for facility-specific information.

– comment # 8 regarding the spray system that operated at the site for a short time in the late 1980s. Two case investigation reports were prepared by the Washington State Department of Agriculture; one in July 1991, and one in May 1992. The reports summarized the Department of Agriculture's investigation of Cenex sludge disposal on the farm property and are listed in the Reference section.

– comment # 14 in the Response to Comments section later in this report for information on the Nielson Trailer Park (now Country Corner) well. EDB was used extensively in the past as a soil fumigant and as a leaded-gasoline additive, and is occasionally detected in domestic well water in areas where it was used. Examples in Washington state include Thurston and Whatcom county.

Ecology can be contacted for information on the labs used to analyze the water samples. The commenter can refer to WDOH response to comment # 1 regarding the request for a health survey.

12. Resident is concerned about her health. She has colon and liver cancer and thyroid problems. Resident used to work at nearby potato plant. She wants to know the health problems of others in the area and local cancer rates compared to national rates.

The commenter can refer to Table 1 and the Health Outcome Data Evaluation section of this health assessment for a detailed discussion of specific Quincy area cancer incidences, compared to expected cancer incidences.

No information was provided to WDOH regarding potential chemical exposures of potato plant employees. Occupational exposures are regulated by the Department of Labor and Industries, although WDOH is available to assist in evaluating the results of any such exposure monitoring.

Cancer is the most common cause of death in Washington adults, aged 45 to 74. Be it breast, lung, or prostate, cancer of some form will likely strike 1 in 3 Washington residents in their lifetime. WDOH's *1997 Cancer in Washington* report, released in late October 1999, summarizes data on the state's 24 most common types of cancer. In 1997, there were 26,517 new cases of cancer overall. Breast cancer is the most common type of cancer, followed by prostate, lung, and colorectal cancer and melanoma. Lung cancer accounts for almost 30% of all cancer deaths in Washington State.

13. Resident's 28-year-old child has chronic fatigue syndrome and attended local schools. Resident's second child (18 years old) has chronic headaches, chronic fatigue syndrome, and has twice had mono. He was tested and had elevated levels of aluminum. Their drinking water was tested and was high in nitrates, but not high in aluminum.

Currently, there is no known cause or a specific biological indicator for the illness commonly referred to as chronic fatigue syndrome. An estimated 90% of mononucleosis cases are caused by the Epstein-Barr virus (EBV), a member of the herpesvirus group. Most of the remaining cases are caused by certain other herpesviruses, particularly cytomegalovirus.[33] Exposure to environmental chemicals is not a likely cause of mononucleosis. WDOH was not provided specific information about the elevated aluminum levels, although aluminum was not a contaminant of concern at the site.

Ingestion of drinking water containing nitrate at or above the federal drinking water standard (maximum contaminant level, or MCL) of 10 ppm might pose a health hazard for infants due to the risk of methemoglobinemia. A risk also exists for pregnant women drinking water that contains nitrate above the MCL. Although high nitrate levels were found in the shallow groundwater underneath the site, WDOH is not aware of any exposures to the contaminated groundwater.

14. Resident stated her horses became sick and died as a result of eating hay that was grown on the field where the Cenex rinsate pond sludge was spread. Resident had a bad cough while handling the hay and was diagnosed with chronic fatigue syndrome.

WDOH has reviewed two reports prepared by the Washington State Department of Agriculture, which included a discussion of crop impacts after field application of the rinsate pond sludge (see WDOH response to comment # 11). Although one of the reports concluded that "the contents of the Cenex waste pond applied to the 100-acre circle had deleterious effects on plant growth," no evaluation was made on the potential impact the sludge application might have had on the horses. The reports are listed in the Reference section, and should be available for public review. Residual contaminants detected in the field soil samples included atrazine, chlorpyrifos, ethalfluralin, propachlor, dichlobenil, and trifluralin. The residual levels of these contaminants measured in the field soil at the time of the sampling were low (levels ranged from 0.001 ppm to 0.17 ppm—below health comparison levels for soil ingestion). Administrative penalties were issued to Cenex as a result of the sludge application.

WDOH was not provided with specific information (i.e., the levels of pesticides/herbicides in the hay), whereby an estimation of health risk could be made. As noted above, the residual levels of pesticides and herbicides measured in the field after the sludge application were quite low, suggesting that exposure would unlikely have resulted in adverse health effects. If the resident is still concerned about the health effects he or she feels might be related to handling of the hay, WDOH recommends contacting the resident's primary health care physician. The commenter can refer to the response to comment # 13 regarding chronic fatigue syndrome.

15. Resident wants to know when the site will be contained and cleaned up and feels there has been inadequate community responsiveness. Resident owns house "downwind" of the site and notes that a friend who passes by the site is losing his hair. Resident does not like the groundwater testing procedures and wants to know
-- if the tests were for specific chemicals;
-- the source of the "elevated levels of beryllium" found on the site;
– about winter runoff from the site.
Resident feels there is insufficient information available to the public and wants a health survey conducted, especially for the migrant population and a mobile home park near the high school. The resident also is concerned about Hanford wastes in Quincy.

Ecology's site manager can be contacted for an update on current site activities and timeframes for cleanup. Since 1997, there have been numerous community Open Houses and meetings to update area residents about site investigation and cleanup activities. WDOH presented the findings of the preliminary health assessment at a public meeting in 1998. Notices were mailed out well in advance of the meeting.

WDOH could not find anything in the scientific literature which suggests that exposure to the types of contaminants found at the site would result in hair loss.

The groundwater testing procedures were conducted in accordance with an Ecology-approved sampling plan. The testing included the analysis of a broad range of chemicals that were known or suspected to be present at the site.

There were no elevated levels of beryllium detected at the Cenex site. An initial sample analysis report prepared in early 1996 indicated an elevated level of beryllium in a site soil sample. In a letter from Cascade Analytical (the lab that conducted the analysis) to the Department of Ecology dated March 14, 1996, the lab indicated there had been an error in the initial analysis. The error resulted from an electronic failure with the instrument used to analyze the sample batch. Subsequent analysis was conducted that indicated that the beryllium concentration was much lower than the initial analysis had reported. The corrected results were submitted to Ecology on May 15, 1996. WDOH evaluated all sample results, including the beryllium results. The highest concentration was from a sample collected by EPA in 1993. The concentration (1.39 mg/kg) was within the range of natural background concentrations for the area and does not pose a health threat.

The commenter can refer to WDOH's response to comment # 1 regarding the health survey. WDOH is not aware of Hanford wastes in the Quincy area in general, or at the Cenex site, in particular. WDOH evaluated the results of all environmental samples collected during the site investigation. This report summarizes the public health findings.

16. Resident has lived in Quincy since 1956, has no health problems, wants to know if there is still a problem with the site, and the status of the cleanup.

Comment noted. Since removal of the fumigant storage tanks, rinsate pond, and contaminated soil/sludge, the site has not posed a direct contact health threat. Most of the remaining contamination is in the shallow groundwater underneath the site, where exposure is not occurring. A public health hazard would exist only if people were to become chronically exposed to the contaminated groundwater. Groundwater cleanup is being addressed as part of the overall site cleanup plan. The commenter can contact the Ecology site manager regarding the status of the cleanup. Because of the limited scope of the 1998 high school air sampling investigation, WDOH has recommended more comprehensive follow-up air sampling investigations there. The first of these samplings was conducted at the high school in August 2000, and no site-related contaminants were detected. A second follow-up indoor air investigation occurred in late 2000. The results of this investigation will be evaluated by WDOH.

17. Resident is concerned about pesticides getting into the drinking water and is concerned about soil and air exposure to pesticides. Also, the resident wants to know how contaminated the site is, why the site is so close to the school, how long it will take to clean it up, and how the site might affect the family.

Per requirements of the Washington State Model Toxics Control Act (MTCA), Ecology directed Cenex to investigate and clean up the site because of the threat to human health and the environment. Pesticide contamination was one of the concerns, and was evaluated during the Remedial Investigation. Although numerous pesticide/herbicide compounds were detected in site soil and rinsate pond sludge samples, none were detected in the shallow groundwater (although other contaminants *were* detected in groundwater). WDOH determined that, on the basis of the types and concentrations of some elevated pesticides/herbicides detected in site soil samples prior to the 1997 soil removal, a theoretically very low increased cancer risk existed for persons assumed to be chronically exposed. The reader can refer to the Discussion section of this report for a detailed summary of the health risks.

On the basis of the types and concentrations of contaminants detected in site soil, WDOH is not recommending air sampling for pesticides. Since the last version of the health assessment, WDOH conservatively estimated pesticide exposures using a dust inhalation model (see Appendix A), and concluded that exposures would have been below levels of health concern (see previous responses regarding dust). WDOH has offered to review and evaluate any air sampling plans, air dispersion model results, or air sampling test results which Cenex, other agencies, or individuals might wish to develop and collect.

WDOH does not know the reasons for citing the schools in their current locations. Quincy's Planning/Zoning Department is probably the best source of information on this.

No VOCs (the primary class of contaminants of concern detected in site groundwater) were detected in the most recent Quincy well samples. The owner/operator of the resident's water system can be contacted for the most current water testing information. WDOH is available to evaluate the results of such tests.

18. Resident wants to know whether the rash on her daughter's neck is related to the site. The resident also wants to know the concentration of contaminants in the groundwater and if her son, who attends the school, might be exposed to the site contamination. The resident wants the site cleaned up and wants to be assured that her family will not be harmed.

Maximum groundwater contaminant concentrations are summarized in Table A5 of this report. Groundwater testing since then has revealed similar contaminant concentrations.

Some laboratory studies have shown that rodents exposed to high concentrations (much higher than levels detected at the site) of some of the detected contaminants developed redness and/or skin sensitization. Trifluralin, for example, might produce allergic reactions in certain people at high concentrations. However, skin contact with even the highest levels of contaminants found at the site would not be expected to result in skin rashes.

Although it is possible that exposure to site contaminants occurred by means of periodic fugitive dust emissions from the Cenex site, on the basis of the results of the particulate model discussed previously, WDOH does not believe a health threat existed.

Since 1997, under an Ecology Order, the site has undergone extensive investigation and cleanup. The Remedial Action Workplan addresses additional planned site remedial actions.

19. Resident is concerned that his school-aged children are being exposed to the site and that chemicals from the site could contaminate the drinking water.

Past releases of chemicals at the site *did* contaminate the groundwater, although the groundwater in the area of contamination is not believed to be used as a source of drinking water. Residents in the area obtain their water from Quincy municipal wells, which, to date, have not been impacted by the site. Under an Ecology Order, Cenex has been directed to clean up the site, including the contaminated groundwater. The commenter can refer to WDOH's previous responses concerning exposures at the adjacent schools. Groundwater, soil gas, and indoor air samplings have been conducted on the high school property. The initial, limited 1998 air sampling investigation revealed the chemical 1,2-DCP in the staff lounge, and was evaluated in this health assessment.

Because of the limited scope of that investigation, WDOH recommended more comprehensive air sampling at the high school. A more complete indoor air quality study was performed at the high school in August 2000, and no 1,2-DCP was detected. A similar, follow-up indoor air investigation was conducted in November 2001.

20. Resident wants to know if her renal problems are related to site contaminants, wants to know the levels of site contaminants, and wants to know whether her drinking water is contaminated. She also wants to know if her family's health is at risk from site contaminants and whether the contaminants could affect pregnancies. She has had two miscarriages and wants the site cleaned up and moved out of the area.

The levels of site contaminants are summarized in Appendix A of this report. Those contaminants found at levels that required further evaluation by WDOH are highlighted in the data tables, and are discussed in the report.

WDOH was not provided with a water sample analysis report for the commenter's well, so cannot evaluate the results. Extensive groundwater testing in the immediate vicinity of the Cenex site has revealed substantial shallow groundwater contamination (predominantly volatile organic compounds and nitrate). However, after extensive records searches, followed by field investigations, WDOH and the Grant County Health District were unable to locate any private wells being used for domestic purposes in the impacted area. If the commenter is concerned about possible well contamination, WDOH or the Grant County Health District can provide the names of certified testing laboratories. WDOH is available to evaluate the results of any such tests.

After careful evaluation of available environmental sampling results, WDOH concluded that chronic noncancer health effects (such as kidney or liver disease) are unlikely to result from exposure. Adverse reproductive or developmental health effects also would not be expected. Under a very conservative exposure scenario (assuming long-term ingestion, skin contact, and inhalation of the most contaminated soil), WDOH estimated there was a theoretically slight increased chance of developing cancer.

The site is being cleaned up under the provisions of Washington state's hazardous waste cleanup law (MTCA). Although WDOH can recommend actions to protect public health, WDOH has no regulatory authority regarding Cenex's future plans.

21. Resident lived in Quincy from 1969–96, including locations near the site, and has renal cell carcinoma. She currently works at Simplot and feels there are an unusually high number of rare cancers in the community.

The commenter can refer to previous WDOH responses and the Health Outcome Data Evaluation section of this report concerning cancer incidences reported for the Quincy area. The Ecology site manager can be contacted to request any available environmental sampling information for the Simplot facility.

22. A resident is concerned about a substance he and school kids ran through and inhaled. The substance had a salty/acidic taste and was on their arms, face, and clothing. He is concerned that the school's ventilation system lets in diesel fumes and is concerned about the drinking water.

A rinsate pond spray evaporation system operated for a short period of time at the Cenex site in the late 1980s. Reportedly, overspray from that system periodically migrated toward the school and came into contact with staff and students for a short period of time during track. Although a single rinsate pond sample was collected and analyzed, rinsate spray samples were not. As a result, WDOH cannot measure the exposures to which the commenter refers. The commenter can refer to WDOH response to question # 8 for further discussion.

The Department of Labor and Industries can be contacted if there is reason to believe there is a chronic indoor air problem at the school. If vehicles are responsible for the diesel exhaust, the school should consider simply having the vehicles park in a different location. (i.e., further from ventilation intakes). Tim Hardin, an indoor air specialist with the Department of Health (360-236-3363), can be contacted for additional information. *Indoor Air Quality: Tools for Schools Action Kit* provides useful information and additional contacts on indoor air quality issues. Tim Hardin can be contacted for information on how to obtain copies.

State drinking water regulations require the school's drinking water to be tested periodically. It is WDOH's understanding that the school uses water supplied by the city's municipal wells. To date, there is no evidence that these wells have been impacted by the Cenex groundwater plume.

23. Resident's father has liver problems, Alzheimer's disease, bladder cancer, nerve and heart damage, bronchial asthma, and a hernia. He worked at the site for about 1 year in 1976. Resident cannot find records of chemicals her father was exposed to while he cleaned the inside of pesticide tanks. He had a chemical injury in 1976, but resident states that many of her father's medical records are gone.

WDOH is not routinely provided with employee medical records, nor has WDOH been provided with the details of the employee's workplace exposure. Employers are required to provide access to employee medical records. Without proper respiratory and skin protection, the potential for significant chemical exposures while cleaning the inside of pesticide tanks is significant. Under existing state and federal Occupational Health and Safety, and Employee Right-to-Know laws, employees are entitled to know the types and hazards of the chemicals they are exposed to in the workplace. Chemical-specific Material Safety Data Sheets are one such source of information. If the potential exists for significant workplace exposures, employers are also required to provide employees with appropriate personal protective equipment. The employee should contact the Washington State Department of Labor and Industries (Compliance Branch), if he feels there were health and safety violations. If more detailed occupational exposure data is provided that suggests a workplace hazard exists(ed), WDOH can work with the Department of Labor and Industries and consult with occupational health physicians who specialize in the medical evaluation of environmental and occupational exposures to determine if a follow-up medical evaluation should be considered.

WDOH evaluated all Cenex site environmental sampling data, and concluded that exposures to site contaminants were not at levels expected to result in the kinds of health effects the resident described.

24. Resident's family is healthy and feels there is unsubstantiated blame by the media and inaccurate information being communicated by the media and some residents about the site.

Comment noted.

Conclusions

1. Current conditions at the Cenex site are not likely to cause adverse health effects or disease, and do not pose a public health hazard.

2. After careful evaluation of all available environmental sampling data, WDOH determined that no apparent public health hazard existed for adults and children assumed to be exposed in the past, through ingestion, skin contact, or inhalation, to contaminants found in soil at the Cenex site. Contaminants were not at levels expected to result in adverse noncancer health effects, although a theoretically slight increased cancer risk was estimated for persons assumed to be exposed continuously, over many years.

3. Potential health risks from exposure to contaminants in dust generated at the Cenex site were evaluated using EPA's particulate emission model, and were estimated to be below a level of health concern.

4. Exposure to the level of 1,2-dichloropropane detected in one room during a limited-scale, 1998 high school indoor air sampling event is not expected to result in chronic health problems for most people. A more comprehensive air quality study conducted at the high school in August 2000 found no 1,2-DCP or other site-related VOCs. Some chemicals were detected during this air sampling investigation, but below levels of health concern. A similar indoor air investigation was conducted inside the high school in November 2001, the results of which will be evaluated in a separate health consultation.

5. Contaminated groundwater at the Cenex site does not represent a public health hazard, since it is not being used for domestic purposes.

6. Past exposure of students and staff at the junior high school to overspray from the former Cenex rinsate pond spray system represents an indeterminate public health hazard. No air sampling of the overspray mist was conducted during its brief operation, so measurement of staff and student exposures is not possible. However, on the basis of the limited number and concentrations of chemicals detected in a rinsate pond sample, and the limited timeframe in which exposures would have occurred, a long-term health risk is not expected.

7. Using all available data (1992–1998), WDOH evaluated the 24 major cancer types, cancers with unknown primary site, all other cancers, and all cancers combined that were reported for Quincy during this time period. The analysis indicates the total number of reported cancer cases is significantly less than would be expected in another Washington State community of the same size and age structure. "Unknown primary site" was the only category for which there was a statistically significant excess number of cancer cases than would be expected. Since these cases were different types of cancer, it is very unlikely that they would have had a common underlying cause.

Recommendations

1. Cenex should continue to remediate and monitor the site per Ecology's requirements.

2. To verify that chemicals are not present at levels of health concern, another round of indoor air sampling (similar to the August 2000 round) should be conducted inside Quincy high school. The indoor air samples should include analysis for 1,2-dichloropropane and other VOCs that were identified as contaminants of concern in the groundwater at the Cenex site. The sampling should occur during the winter season, to evaluate conditions different, and potentially "worse" than those in August. Results of any such testing should be provided to WDOH or ATSDR for evaluation.

   Follow-up indoor air sampling was conducted in November 2001. The results will be evaluated in a separate health consultation.

3. WDOH should be notified in the event any domestic water supply wells are identified that could be threatened by the contaminated groundwater plume originating from the Cenex site.

Public Health Action Plan

The Public Health Action Plan (PHAP) outlined below for the Cenex site is a description of actions already taken, and actions planned. The purpose of the PHAP is to ensure that this health assessment not only identifies public health hazards, but provides a plan of action designed to prevent or mitigate adverse human health effects resulting from exposure to hazardous substances in the environment.

Actions taken by Cenex, Ecology, and EPA

1. Since 1993, the U.S. Environmental Protection Agency, Ecology, and Cenex have conducted extensive on-site and off-site environmental sampling in soil, soil gas, groundwater, and air.

2. From August 1994 to February 1995, Cenex contractors, with Ecology oversight, decontaminated and removed all tanks of the former fumigant storage facility.

3. A total of 360 tons (277 cubic yards) of soil and concrete removed from the rinsate pond was transported to the Rabanco Landfill on May 1 and 2, 1997. The site was wet down, and clean gravel was placed over the site to suppress dust emissions.

4. Ecology and Cenex have sponsored numerous Open Houses and meetings to update the community about the status of the site investigation and clean-up activities.

5. In February 1998, a limited-scale air sampling investigation was conducted by Cenex in and around the Quincy high school, followed by more comprehensive indoor air sampling investigations in August 2000 and November 2001.

6. Cenex and Ecology entered into an Agreed Order in 1998 to clean up contamination near the Cenex site rinsate pond and storage facility.

7. In cooperation with Ecology, Cenex conducted various interim actions, including the installation of a soil vapor extraction system, field scale testing of air sparging technology, and installation of additional monitoring wells.

8. In May 2000, a Feasibility Study was finalized that describes the results of the interim actions and evaluates the remedial alternatives that address cleanup of the site.

9. In early 2001, Ecology selected the final clean-up action based upon MTCA criteria. Cenex and Ecology entered into a Consent Decree to perform the clean-up actions.

10. In August 2001, Cenex prepared a draft Remedial Action Workplan, including engineering design documents. The documents summarize the following proposed actions; (1) asphalt capping of on-property soils, (2) installation of various on-property

soil vapor and groundwater treatment systems, (3) monitoring and institutional controls to prevent exposures to off-property contaminated groundwater, and (4) air monitoring at Quincy high school. These documents were available for public comment.

Actions taken by WDOH and ATSDR

1. On April 23, 1997, WDOH sponsored an Open House to meet with area residents, and to document their health concerns.

2. On June 5, 1997, WDOH sponsored a meeting with representatives of Cenex, Ecology, Grant County, and Washington State University to review site information, and to assess the existence of private wells in the vicinity of the Cenex site that could potentially be affected by the contaminated groundwater plume.

3. In October 1997, WDOH prepared a letter summarizing all site activities since early summer 1997, and activities planned for the future. The letter was mailed to attendees of the Quincy Open House, Cenex, area residents, and agency representatives.

4. On December 16, 1997, WDOH attended an Open House in Quincy to share the results of the preliminary health assessment, to provide site-specific chemical information, and to address questions from the community, media, and agencies.

5. In April 1998, WDOH mailed update letters to area residents summarizing the findings of the preliminary health assessment.

6. On August 18, 1998, WDOH presented the findings of the preliminary health assessment at an Ecology-sponsored public meeting in Quincy.

7. On April 11, 2000, WDOH attended a Quincy Concern-sponsored meeting held in Quincy to address questions about the preliminary health assessment.

8. In August 2000, ATSDR evaluated the results of indoor air samples collected inside Quincy High School. The results of the agency's evaluation are presented in a health consultation report, copies of which were sent to Quincy High School, agency representatives, Quincy City Hall, the Quincy public library, and others. Follow-up indoor air testing at Quincy high school was conducted in November 2001. The results of this testing will be evaluated by WDOH.

9. In early 2002, WDOH released the final public health assessment for the Cenex site, along with a fact sheet summarizing the findings of the health assessment. The health assessment and/or fact sheet was mailed to Ecology, Grant County, Cenex, area residents, representatives, the local library, and others.

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Appendix A: Data Tables

Table A1: 1993 EPA & 1995 Cenex site soil volatile organic compound (VOC) concentrations (in mg/kg) ✚

	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sample		
Chemical	**RPS1 EPA**	**RPS2 EPA**	**RPS3 EPA**	**RPS4 EPA**	**RPS5 EPA**	**SS1 * EPA**	**SS2 EPA**	**SS3 EPA**	**SS4 EPA**	**SS5 EPA**	**1995 Cenex**	**CV ★ (child)**	**CV (adult)**
Acetone			0.059				0.04	0.042		0.07		5,000 RMEG	70,000 RMEG
Benzene		0.001						0.0003				20 - CREG	20 - CREG
Chloroform			0.002									100 - CREG 500 - EMEG	100 - CREG 7,000 - EMEG
1,2-Dichloropropane	0.006	0.003	1	0.2	0.052		0.005		0.0004		1.5	5,000 - EMEG	60,000 - EMEG
1,2,4-Trimethylbenzene (pseudocumene)	0.015		0.022	0.01								3,900 - EPA	3,900 - EPA
1,3,5-TMB (mesitylene)	0.006		0.036	0.009								3,900 - EPA	3,900 - EPA
Chlorobenzene	0.092	0.008	0.22	0.034	0.026				0.019			1,000 - RMEG	10,000 - RMEG
1,3-Dichloropropane	0.002		0.076	0.019	0.009							N/A	N/A
Total Xylenes	0.068	0.002	0.152	0.045	0.003							10,000 - EMEG	100,000 - EMEG
cis-1,3-Dichloropropene	0.005										0.009	20 - RMEG	200 - RMEG
trans-1,3-Dichloropropene	0.006										0.009	20 - RMEG	200 - RMEG
Chloromethane		0.002	0.002		0.002							76.9 - MTCA B	76.9 - MTCA B
Naphthalene		0.039	0.079	0.009								1,000 - EMEG	10,000 - EMEG
2-Butanone (MEK)			0.026				0.007	0.012				30,000 - RMEG	400,000 - RMEG
Ethylbenzene			0.009	0.002								5,000 - RMEG	70,000 - RMEG
2-Chlorotoluene	0.039	0.009	0.16	0.069	0.011							1,000 - RMEG	10,000 - RMEG
Tetrachloroethene (PERC)			0.003									10 - CREG 500 - RMEG	7,000 RMEG
1,1,1-TCA	0.008			0.001								1,600 - EPA	1,600 - EPA
Chloroethane (ethyl chloride)				0.001								220 - EPA	220 - EPA
1,1,2-TCA					0.001							10 CREG 200 - RMEG	10 - CREG 3,000 - RMEG
Carbon disulfide							0.008			0.028		5,000 - RMEG	70,000 - RMEG
1,2,3-Trichloropropane							0.002					300 - RMEG	4,000 - RMEG
1,1-Dichloroethene									0.0002			1 - CREG 500 - EMEG	1 - CREG 6,000 - EMEG

* Background soil sample
★ CV = health comparison value
✚ No soil VOCs exceeded health comparison values
EPA comparison values are from EPA Region III risk-based concentration (RBC) Table

Table A2: 1993 EPA & 1995 Cenex site herbicide/pesticide concentrations in soil/sludge (in mg/kg)

	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sample	Comparison value (child)	Comparison value (adult)
Chemical	**RPS1 * EPA**	**RPS2 EPA**	**RPS3 EPA**	**RPS4 EPA**	**RPS5 EPA**	**SS1 ** EPA**	**SS2 + EPA**	**SS3 EPA**	**SS4 EPA**	**SS5 EPA**	**1995 Cenex**		
Disulfoton (insecticide)	8.79	146	4.67	3.37							4.93	3 - EMEG	40 - EMEG
Diuron	0.295		0.764	0.753			0.93		3.79			100 - RMEG	1,000 - RMEG
Cycloate	0.79											N/A	N/A
Trifluralin (Treflan) (herbicide)	158	57.7	295	349	0.98		294				138	400 - RMEG 90 - CREG	5,000 - RMEG 90 - CREG
Atrazine	5.25	0.694	21.3	38.6			0.735				8.51	4.55 - MTCA B	4.55 - MTCA B
Vernolate (vernam) (herbicide)	42.2	2.89	112	78.3	0.347		6.87				89.7	50 - RMEG	700 - RMEG
Triallate (Fargo)	2.67	1.57	7	8.65			3.21					1,040 - MTCA B	1,040 - MTCA B
Chlorpyrifos (insecticide)	19.6	1.31	19.2	4.75			162					50 - EMEG	700 - EMEG
Tolban (profluralin)	3.51	19.7	192	92			3.92					480 - MTCA B	4,200 - MTCA B
Pendimethalin (Prowl)	14	8.68	20.5	24.8			9.12					2,000 - RMEG	30,000 - RMEG
Hexazinone (Velpar)	1.16	1	1.77	2.14	5.33				0.674			2,640 - MTCA B	2,640 - MTCA B
Ethalfluralin (Sonalan) (herbicide)	373	120	1,530	917			557				478	N/A	N/A
Eptam (EPTC)	45.7	3.47	406	98.4	0.565		2.36					1,000 - RMEG	20,000 - RMEG
Alachlor (Lasso)							19.8	0.529			3.4	12.3 - MTCA B	12.3 - MTCA B
Metolachlor							33.9					8,000 - RMEG	100,000 - RMEG
Bromacil								0.551				N/A	N/A
Terbacil									1.86			1,040 - MTCA B	1,040 - MTCA B

***** RPS = subsurface soil/sludge samples ** background sample + SS2-SS5 = surface soil samples

Shaded cells = contaminant exceeds health comparison value and was further evaluated in the health assessment

Table A3: Maximum Cenex site soil metal concentrations (in mg/kg)

Chemical	**1995 - Cenex**	**1993 - EPA (Sample # RPS4)**	**Noncancer CV (Child)**	**Noncancer CV (Adult)**	**Cancer CV**	**90th percentile Background (Yakima Basin)**
Beryllium	0.979	1.39	100 - RMEG	1,000 - RMEG	0.233 (MTCA B)	1.57
*Chromium	181	360	200 - RMEG	2,000 - RMEG	NA	38.27
Cadmium	8	25.2	10 - EMEG	100 - EMEG	NA	0.93
Zinc		6,620	20,000 - EMEG	200,000 - EMEG	NA	78.71
Thallium		6.7	5.6 - MTCA B	5.6 - MTCA B	NA	NA
Manganese		397	7,000 - RMEG	100,000 - EMEG	NA	1,105

* assumes hexavalent chromium

Shaded cells = contaminant exceeds health comparison value and was further evaluated in the health assessment

Table A4: 1993 EPA Cenex site soil phenoxyherbicide concentrations[34] (in mg/kg) ✚

	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Child CV	Adult CV
Chemical	**RPS1 EPA**	**RPS2 EPA**	**RPS3 EPA**	**RPS4 EPA**	**RPS5 EPA**	**SS1 * EPA**	**SS2 EPA**	**SS3 EPA**	**SS4 EPA**	**SS5 EPA**		
Dinoseb					0.066			0.035			50 - RMEG	700 - RMEG
MCPP + (Mecoprop)					27						N/A	N/A
MCPA ++											30 - RMEG	400 - RMEG
2,4-D	3.7	8.5	27.5	20.3	14.1	0.065	1		0.45		500 - RMEG	7,000 - RMEG
2,4-DB	0.48	0.5	4.6	0.48	1.52		0.87	0.49	0.69		400 - RMEG	6,000 - RMEG
Chloramben					0.068	0.42					N/A	N/A
Dacthal (DCPA)	0.35	0.3	0.17	0.17	0.39	4.6	0.058	0.015	0.022		500 - RMEG	7,000 - RMEG
Dicamba (Banvel)	0.33	1	3.3	2.68	0.6		0.095				2,000 - RMEG	20,000 - RMEG

+ 2-(4Chloro-2-methylphenoxy) propanoic acid
++ (4-Chloro-2-methylphenoxy) acetic acid
* background sample
✚ No phenoxyherbicides exceeded health comparison values in soil

Table A5: Maximum VOC, nitrate, and ammonia concentrations in the Cenex groundwater plume[35] (in µg/l)

Chemical	Maximum Concentration	Health Comparison Value	Maximum Contaminant Level (MCL)
Bromodichloromethane	2.4	0.6 - CREG	N/A
Carbon Tetrachloride	5.6	0.3 - CREG	5
Chlorobenzene	91	4,000 - Child EMEG	100
Chloroform	73	6 - CREG	100
Chloromethane	5.8	3 - LTHA	N/A
1,2-Dibromoethane (EDB)	23	0.0004 - CREG	0.05
1,1-Dichloroethane	19	800 - MTCA B	N/A
1,2-Dichloroethane	136	0.4 - CREG	5
1,1-Dichloroethene	18	0.06 - CREG	7
1,2-Dichloropropane	35,410	900 - EMEG	5
1,3-Dichloropropane	1,650	N/A	N/A
1,1-Dichloropropene	3.1	N/A	N/A
1,3-Dichloropropene	1.6		
Methylene Chloride	1.7	5 - CREG	5
1,1,2-Trichloroethane	154	0.6 - CREG	5
1,2,3-Trichloropropane	1,700	40 - LTHA	N/A
Vinyl Chloride	7.2	0.2 - EMEG	2
Nitrate (mg/l)	279	20 - RMEG	10
Ammonia (mg/l)	471	210 - EPA	210 - EPA

Shaded cells = contaminant exceeded a health comparison value or drinking water standard
MCL = Safe Drinking Water Act maximum contaminant level
CREG = ATSDR cancer risk evaluation guide
EMEG = ATSDR environmental media evaluation guide
LTHA = long-term health advisory
RMEG = ATSDR reference dose media evaluation guide
MTCA B = Washington State Department of Ecology Model Toxics Control Act method B clean-up level

Table A6: Cenex site soil VOC & metal concentrations (in mg/kg), June 1997

Chemical	Sample # BH1	Sample # BH2	Sample # BH3	Sample # BH4	Sample # BH5	Sample # BH6	Health Comparison Value
Chlorobenzene	4.8						1,000 - child RMEG 10,000 - adult RMEG
1,2-Dichloropropane	15, 2.1	1.2, 1.7			1.5, 3.7	0.66, 0.81, 1.1	5,000 - child EMEG 60,000 - adult EMEG
1,3-Dichloropropane	6.8, 1.1	0.28, 0.26			0.77		N/A
cis 1,3-Dichloropropene							20 - child RMEG 200 - adult RMEG
trans 1,3-Dichloropropene							20 - child RMEG 200 - adult RMEG
1,1,2-Trichloroethane					0.21		200 - child RMEG 10 - CREG
1,2,3-Trichloropropane					0.69	0.2, 0.45	300 - child RMEG 4,000 - adult RMEG
+Beryllium	0.3, 0.2	0.4, 0.1	0.1, 0.3	0.4, 0.2	0.2, 0.2	0.2, 0.2	100 - child RMEG 0.233 - MTCA B
Cadmium	0.25, 0.47	0.65	0.59, 0.24	0.49, 0.32			10 - child EMEG 100 - adult EMEG
* Chromium	10.1, 14.2	10.9, 9.3	9.2, 17.9	12.8, 14.6	9.1, 12.9	8.7, 11.7	*200 - child RMEG

* For hexavalent chromium

+ All beryllium samples were below the natural background concentration [3]

Table A7: Cenex site soil pesticide/herbicide, ammonia, and nitrate concentrations (in mg/kg)
June 1997 (after soil remediation)

Chemical	Sample # BH1	Sample # BH2	Sample # BH3	Sample # BH4	Sample # BH5	Sample # BH6	Sample # *BGS	Sample # **BGN	Health Comparison Value
Alachlor (Lasso)	0.031, 0.026				0.023		0.014		500 - child RMEG 7,000 - adult RMEG
Ethalfluralin					0.363	0.005			N/A
Trifluralin	0.003		0.01		0.298	0.001	0.001		90 - CREG 400 - child RMEG 5,000 - adult RMEG
Atrazine									2,000 - child RMEG 20,000 - adult RMEG
Disulfoton									3 - child EMEG 40 - adult EMEG
Vernolate					0.295				50 - child RMEG 700 - adult RMEG
Nitrate-N	40, 12	28.5, 6.4	35.5, 42.5	780, 200	24, 140	934, 242	16	8.5	80,000 - child RMEG 100,000 - adult RMEG
Ammonia-N	80, 21	480, 16	140, 1,100	320, 6.3	1,500, 1,500	3,500, 10	6.2	7.6	20,000 - child EMEG 200,000 - adult EMEG

* Sample was collected from the south border of the Quincy Junior High School athletic field
** Background soil sample was collected from the Habitat for Humanity property, immediately northwest of the Cenex site

Table A8: Cenex site soil gas VOC concentrations (in mg/m^3)

Location	Date	chlorobenzene	chloroform	1,1-DCE	1,2-DCP	vinyl chloride	PID
VP1	7/1/97	N/D	N/D	N/D	N/D	N/D	N/D
VP2	7/1/97	N/D	N/D	N/D	16	N/D	3
VP3	7/1/97	N/D	2.8	N/D	165	N/D	10
VP4	7/1/97	N/D	3.4 (≈ 0.7 ppm)	N/D	791(≈ 171 ppm)	N/D	30
VP5	7/1/97	4.3 (≈ 1 ppm)	3.1	3 (≈ 0.76 ppm)	3,010 (≈ 651 ppm)	3.7 (≈ 1.45 ppm)	88
VP6	7/1/97	3.4	2.6	N/D	197 (≈ 42.6 ppm)	N/D	49

Table A9: Maximum modeled and measured Cenex site ambient air VOC concentrations

Chemical	Modeled VOC Concentration (24 meters from stack)	Cancer CV	Noncancer CV	Measured Concentration
Chloroform	0.00048 $\mu g/m^3$ (=0.0024 ppb)	0.04 $\mu g/m^3$ (CREG)	20 ppb (chronic EMEG)	ND
Vinyl chloride	0.00095 $\mu g/m^3$ (=0.0024 ppb)	N/A	30 ppb (Int. EMEG)	ND
1,2-DCP	0.1 $\mu g/m^3$ (=0.46 ppb)	N/A	7 ppb (Int. EMEG)	ND
Chlorobenzene	0.00095 (=0.0044 ppb)	N/A	18 $\mu g/m^3$ (EPA Region 3)	ND
1,1-DCE	N/A	0.02 $\mu g/m^3$ (CREG)	20 ppb (Int. EMEG)	ND

ND = not detected
CV = health comparison value

Table A10: Quincy high school 3-M badge air monitoring results
1,2-dichloropropane
(February 18–23, 1998)

Location	Concentration ($\mu g/m^3$)	Method detection limit ($\mu g/m^3$)	EPA RfC ($\mu g/m^3$)	ATSDR EMEG ($\mu g/m^3$)
West side of school bldg.	< 4.6	4.6	4	32 (7 ppb)
Boiler Room	< 4.6	4.6	4	32
Boiler Room Sump Basket	< 4.6	4.6	4	32
Kitchen	< 4.6	4.6	4	32
Main Office	< 4.6	4.6	4	32
Staff Lounge	17 (3.7 ppb)	4.6	4	32
Cafeteria	< 4.6	4.6	4	32
Band Room	< 4.6	4.6	4	32
Library	< 4.6	4.6	4	32
Science Room	< 4.6	4.6	4	32
Outside Dugout	< 4.6	4.6	4	32

Shaded cell = contaminant exceeded the EPA reference concentration (RfC)

Table A11: Cenex site child exposure dose estimates and reference doses

Contaminant	Maximum Concentration (mg/kg)	Soil Ingestion Rate (mg/day)	Exposure Duration (years)	Estimated Exposure Dose (mg/kg/day)	EPA Reference Dose (mg/kg/day)
Trifluralin	349	50	10	0.0004	0.0075
Ethalfluralin	1,530	50	10	0.002	0.0075 (used RfD for Trifluralin)
Disulfoton	146	50	10	0.0002	0.00004
Chlorpyrifos	162	50	10	0.0002	0.003
Vernolate	112	50	10	0.0001	0.001
Alachlor	19.8	50	10	0.00003	0.01
Atrazine	38.6	50	10	0.00005	0.035
Cadmium	25.2	50	10	0.000017	0.001
Chromium	360	50	10	0.0002	0.003
Thallium	6.7	50	10	0.000005	0.00008
Beryllium	1.39	50	10	0.00003	0.002

Shaded cell = Estimated dose above EPA reference dose

Table A12: Cenex site adult exposure dose estimates and reference doses

Contaminant	Maximum Concentration (mg/kg)	Soil Ingestion Rate (mg/day)	Exposure Duration (years)	Estimated Exposure Dose (mg/kg/day)	EPA Reference Dose (mg/kg/day)
Trifluralin	349	50	23	0.0003	0.0075
Ethalfluralin	1,530	50	23	0.001	0.0075 (used RfD for Trifluralin)
Disulfoton	146	50	23	0.0001	0.00004
Chlorpyrifos	162	50	23	0.0001	0.003
Vernolate	112	50	23	0.0001	0.001
Alachlor	19.8	50	23	0.00002	0.01
Atrazine	38.6	50	23	0.00003	0.035
Cadmium	25.2	50	23	0.00001	0.001
Chromium	360	50	23	0.0002	0.003
Thallium	6.7	50	23	0.000003	0.00008
Beryllium	1.39	50	23	0.0000007	0.002

Shaded cell = estimated dose above EPA reference dose

Table A13: Estimated child cancer and noncancer risks

Contaminant	Maximum Concentration (mg/kg)	Ingestion Rate (mg/day)	Exposure Duration (years)	Hazard Quotient* (noncancer)	Estimated Increased Cancer Risk
Trifluralin	349	50	10	0.05	5×10^{-7}
Ethalfluralin	1,530	50	10	0.27	2×10^{-6}
Disulfoton	146	50	10	5	N/A
Chlorpyrifos	162	50	10	0.07	N/A
Vernolate	112	50	10	0.1	N/A
Atrazine	38.6	50	10	0.001	2×10^{-6}
Alachlor	19.8	50	10	0.003	3×10^{-7}
Beryllium	1.39	50	10	0.015	6×10^{-7}
Cadmium	25.2	50	10	0.017	N/A
Chromium	360	50	10	0.07	N/A
Thallium	6.7	50	10	0.06	NA
				Total (Hazard Index) ~ 5.6	*Total ~ 5×10^{-6}*

*** =** Hazard quotient less than 1 indicates that noncancer health risks are unlikely to result from exposure.
NA = Cancer slope factor not available.

Table A14: Estimated adult cancer and noncancer risks

Contaminant	Maximum Concentration (mg/kg)	Ingestion Rate (mg/day)	Exposure Duration (years)	Hazard Quotient * (noncancer)	Estimated Increased Cancer Risk
Trifluralin	349	50	23	0.04	8×10^{-7}
Ethalfluralin	1,530	50	23	0.13	3×10^{-6}
Disulfoton	146	50	23	2.5	N/A
Chlorpyrifos	162	50	23	0.03	N/A
Vernolate	112	50	23	0.1	N/A
Atrazine	38.6	50	23	0.0009	2×10^{-6}
Alachlor	19.8	50	23	0.002	4×10^{-7}
Beryllium	1.39	50	23	0.0006	1×10^{-6}
Cadmium	25.2	50	23	0.01	N/A
Chromium	360	50	23	0.07	N/A
Thallium	6.7	50	23	0.04	NA
				Total (Hazard Index) ~ 2.9	*Total ~ 7 x* 10^{-6}

***** = Hazard quotient less than 1 indicates that noncancer health risks are unlikely to result from exposure.
NA = Cancer slope factor not available.

Table A15: Modeled Cenex site dust inhalation cancer and noncancer risks

Contaminant	Soil concentration (mg/kg)	Modeled air concentration	Estimated cancer risk (child)	Hazard Quotient (noncancer risk) (child)	Estimated cancer risk (adult)	Hazard Quotient (noncancer risk) (adult)
atrazine	38.6	5.86E-8	NA	5.5E-7	NA	3.4E-7
alachlor	19.8	3E-8	NA	9.8E-7	NA	6.1E-07
chlorpyrifos	162	2.5E-7	NA	2.7E-5	NA	1.7E-5
disulfoton	146	2.2E-7	NA	1.8E-3	NA	1.1E-3
ethalfluralin	1,530	2.3E-6	7.8E-10	1E-4	7.2E-10	6.3E-5
trifluralin	349	5.3E-7	1.8E-10	2.3E-5	1.7E-10	1.4E-5
thallium	6.7	1E-8	NA	4.2E-5	NA	2.6E-5
vernolate	112	1.7E-7	NA	5.6E-5	NA	3.4E-5
cadmium	25.2	3.8E-8	6.9E-11	1.3E-5	6.9E-11	7.7E-6
chromium	360	5.5E-7	6.6E-9	6E-5	6.6E-9	3.7E-5
beryllium	1.39	2.1E-9	5E-12	3.5E-7	5E-12	2.1E-7
Total (sum of cancer and noncancer risks)			7.6E-9	2.1E-3	7.6E-9	1.3E-3

*** =** Hazard quotient less than 1 indicates that noncancer health risks are unlikely to result from exposure.
NA = Cancer slope factor not available

Appendix B: Figures

Appendix C: Soil contact exposure assumptions

Both oral (ingestion) and dermal (skin contact) routes of exposure were evaluated for the 11 contaminants of concern detected in site soil. Maximum detected contaminant concentrations were conservatively used to estimate exposures, even if the level was from a sample detected below ground surface. Dust inhalation exposures were evaluated separately (see Table A15 and Appendix D). The following soil contact exposure assumptions were used in the health assessment:

1. 10-year child exposure duration; 23-year adult/worker exposure duration.

2. 50 milligrams of soil per day adult ingestion rate; 50 milligrams of soil per day child ingestion rate (central tendency rates—EPA Exposure Factors Handbook).

3. 5 days per week, 50 weeks per year exposure frequency for adults; 5 days per week, 36 weeks per year exposure frequency for children.

4. 100% of exposure was at the highest detected concentration for each contaminant of concern.

5. 72 kg adult body weight; 41 kg child body weight.

Appendix D: Exposure Dose Formulas

Soil Ingestion Exposure Dose

$ID_s = (C_s)$ (IR) (CF) (EF) (ED) / (BW) (AT)

where

ID_s = Soil ingestion exposure dose (mg/kg/day)
C_s = Contaminant concentration in soil (mg/kg)
IR = Soil ingestion rate (mg/day)
CF = Conversion factor for soil (0.000001 kg/mg)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (duration over which exposure is averaged-days). For noncarcinogenic effects AT = (ED x 365 days/year); for carcinogenic effects AT = (70 years x 365 days/year), or 25,550 days

Soil Dermal Exposure Dose

AD = C x CF x SA x AF x ABS x EF x ED)/(BW x AT)

where

AD = Absorbed dose (mg/kg/day)
C = Chemical concentration in soil (mg/kg)
CF = Conversion factor (10^{-6} kg/mg)
SA = Skin surface area available for contact (cm^2/event)
AF = Soil-to-skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure frequency (events/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (duration over which exposure is averaged-days). For noncarcinogenic effects AT = (ED x 365 days/year); for carcinogenic effects AT = (70 years x 365 days/year), or 25,550 days.

Appendix D: Exposure Dose Formulas (cont.)

EPA Particulate Emission Model

Inhaled dose (ID) from particulates (modeled)

$$ID = \frac{C \times IR \times EF \times ED \times (1/PEF)}{BW \times AT}$$

$$PEF\ (m^3/kg) = Q/C \times \frac{3600\ s/hr}{0.036 \times (1-V) \times (Um/Ut)^3 \times F(x)}$$

Particulate Emission Model Assumptions

PEF = particulate emission factor (m3/kg) = 6.59×10^8
Respirable fraction (g/m^2-hr) = 0.036
V = fraction of vegetative cover (unitless) = 0.001
Um = mean annual wind speed (m/s) = 4.69
Ut = equivalent threshold value of wind speed at 10 m (m/s) = 11.32
F(x) = function dependant on Um/Ut (unitless) = 0.194
Q/C (m3/kg) = 90.8
CF(s/hr) = 3600

C = Concentration (mg/kg)

IR = inhalation rate (m3/day):
child = 8.3
older child = 14
adult = 15.2

EF = exposure frequency (days/year) = 350

BW = body weight (kg):
child = 15
older child = 41
adult = 72

AT = averaging time (days)

ED = exposure duration (years)

Appendix E: Interim Criteria of Actions for Levels of Public Health Hazard
from PHA Guidance Manual, 1992
Revision Effective May 1, 1999

Category A : Urgent Public Health Hazard

This category is used for sites where short-term exposures (< 1 yr) to hazardous substances or conditions could result in adverse health effects that require rapid intervention.

This determination represents a professional judgment based on critical data that ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.

Criteria

Evaluation of available relevant information* indicates that site-specific conditions or likely exposures have had, are having, or are likely to have in the future, an adverse impact on human health that requires immediate action or intervention. Such site-specific conditions or exposures may include the presence of serious physical or safety hazards, such as open mine shafts, poorly stored or maintained flammable/explosive substances, or medical devices which, upon rupture, could release radioactive materials.

*** Such as environmental and demographic data; health outcome data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data.**

ATSDR Actions

ATSDR will expeditiously issue a health advisory that includes recommendations to mitigate the health risks posed by the site. The recommendations issued in the health advisory and/or health assessment should be consistent with the degree of hazard and temporal concerns posed by exposures to hazardous substances at the site.

On the basis of the degree of hazard posed by the site and the presence of sufficiently defined current, past, or future completed exposure pathways, one or more of the following public health actions can be recommended:

- biologic indicators of exposure study
- biomedical testing
- case study
- disease and symptom prevalence study
- community health investigations
- registries
- site-specific surveillance
- voluntary residents tracking system
- cluster investigation
- health statistics review
- health professional education
- community health education
- substance-specific applied research

Category B: Public Health Hazard

This category is used for sites that pose a public health hazard due to the existence of long-term exposures (> 1 yr) to hazardous substance or conditions that could result in adverse health effects.

This determination represents a professional judgment based on critical data that ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.

Criteria

Evaluation of available relevant information* suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse impact on human health that requires one or more public health interventions. Such site-specific exposures may include the presence of serious physical hazards, such as open mine shafts, poorly stored or maintained flammable/explosive substances, or medical devices which, upon rupture, could release radioactive materials.

*__Such as environmental and demographic data; health outcome data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data.__

ATSDR Actions:

ATSDR will make recommendations in the health assessment to mitigate the health risks posed by the site. The recommendations issued in the health assessment should be consistent with the degree of hazard and temporal concerns posed by exposures to hazardous substances at the site. Actions on the recommendations may have occurred before the actual completion of the public health assessment.

On the basis of the degree of hazard posed by the site and the presence of sufficiently defined current, past, or future completed exposure pathways, one or more of the following public health actions can be recommended:

- biologic indicators of exposure study
- biomedical testing
- case study
- disease and symptom prevalence study
- community health investigations
- registries
- site-specific surveillance
- voluntary residents tracking system
- cluster investigation
- health statistics review
- health professional education
- community health education
- substance-specific applied research

Category C: Indeterminate Public Health Hazard

This category is used for sites when a professional judgment on the level of health hazard cannot be made because information critical to such a decision is lacking.

Criteria

This category is used for sites in which "critical" data are insufficient with regard to extent of exposure and/or toxicologic properties at estimated exposure levels. The health assessor must determine, using professional judgment, the "criticality" of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision.

ATSDR Actions

ATSDR will make recommendations in the health assessment to identify the data or information needed to adequately assess the public health risks posed by the site.

Public health actions recommended in this category will depend on the hazard potential of the site, specifically as it relates to the potential for human exposure of public health concern. Actions on the recommendations may have occurred before the actual completion of the public health assessment.

If the potential for exposure is high, initial health actions aimed at determining the population with the greatest risk of exposure can be recommended. Such health actions include:

- community health investigation
- health statistics review
- cluster investigation
- symptom and disease prevalence study

If the population of concern can be determined through these or other actions, any of the remaining follow-up health activities listed under categories A and B may be recommended.

In addition, if data become available suggesting that human exposure to hazardous substances at levels of public health concern is occurring or has occurred in the past, ATSDR will reevaluate the need for any followup.

Category D: No Apparent Public Health Hazard

This category is used for sites where human exposure to contaminated media might be occurring, might have occurred in the past, and/or might occur in the future, but the exposure is not expected to cause any adverse health effects.

This determination represents a professional judgment based on critical data that ATSDR considers sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases, additional data might be required to confirm or further support the decision made.

Criteria

Evaluation of available relevant information* indicates that, under site-specific exposure conditions, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse impact on human health.

*__Such as environmental and demographic data; health outcome data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data; monitoring and management plans.__

ATSDR Actions

If appropriate, ATSDR will make recommendations for monitoring or other removal and/or remedial actions needed to ensure that humans are not exposed to significant concentrations of hazardous substances in the future. Actions on the recommendations may have occurred before the actual completion of the public health assessment.

The following health actions, which may be recommended in this category, are based on information indicating that no human exposure is occurring or has occurred in the past to hazardous substances at levels of public health concern. One or more of the following health actions are recommended for sites in this category:

- community health education
- health professional education
- community health investigation
- voluntary residents tracking system

However, if data become available suggesting that human exposure to hazardous substances at levels of public health concern is occurring, or has occurred in the past, ATSDR will reevaluate the need for any followup.

Category E: No Public Health Hazard

This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard.

Criteria

Sufficient evidence indicates that no human exposures to contaminated media have occurred, none are now occurring, and none are likely to occur in the future.

ATSDR Actions

No public health actions are recommended at this time because no human exposure is occurring, has occurred in the past, or is likely to occur in the future that may be of public health concern.

Appendix F: Response to Public Comments

Comment 1: Why is the concentration of a chemical in air, water, or soil, which is expected to cause no more than one additional cancer in 1 million persons or one in 100,000 persons over a lifetime, acceptable?

When assessing cancer risks in environmental exposure assessment, the term "acceptable" is typically used to define an exposure(s) in which the risk of developing cancer is still thousands of times lower than the likelihood of the general population developing cancer during their lifetime (i.e., 1 in 4 chance). The term "acceptable" is thus a subjective "line in the sand," which most health and environmental regulatory agencies use in assessing whether further site cleanup is necessary, or whether to recommend actions to reduce or eliminate exposures. Recommendations for reduction or elimination of exposures and environmental cleanups are typically justified at sites where exposures are occurring, or could occur in the future, and the estimated increased cancer risk is greater than 1 in 10,000 or 1 in 100,000.

Comment 2: Who paid for the soil removal; taxpayers or Cenex? Cenex should pay. An example should be made so that other corporations who pollute the environment understand they must "clean up their act."

Cenex paid for the soil removal and has assumed the liability and costs for investigation and cleanup of the Cenex site.

Comment 3: The draft health assessment clearly indicated I was concerned about the smell of diesel exhaust in my classroom. That is correct. The point I tried to make was either not understood, or excluded from the report. To clarify or reiterate, I am not overly concerned with the smell of diesel exhaust, but rather I used it as an example to illustrate how quickly smells (and therefore any air-born particulates, including those from the Cenex site) enter into the classrooms. At some point in time, air movement would have carried drift toward the junior high school. The filter system does not begin to address that level or type of filtration necessary to provide a clean, safe environment for teachers and students. What was the exposure level for staff and students in the building during the rinsate pond's peak use?

Since no sampling of the rinsate pond overspray was conducted during its brief operation in the 1980s, measurement of junior high school staff and student exposures to the overspray is not possible. On the basis of the concentrations and limited number of herbicide/pesticide compounds reported for a single rinsate pond sample, and the limited time in which the exposures would have occurred, a long-term health threat would not be expected.

In January 1998, WDOH was contacted by the commenter regarding concerns expressed about indoor air quality at the junior high school, including concerns about dust accumulation in the school's ventilation system. WDOH followed up the conversation with a letter dated January 21,

1998. WDOH responses to comments # 8 and # 22 in the draft health assessment.(p. 36 and p. 44, respectively) summarized the content of the 1998 letter. WDOH had indicated at the time that it did not think dust accumulation in the ventilation system (if present) posed an immanent health threat. Using an EPA particulate emission model, WDOH has since attempted to estimate a "worst-case" dust inhalation scenario, assuming someone was exposed *at the site* to dust containing the highest levels of all Cenex site soil contaminants of concern. The results of the modeling effort indicate that health risks from dust inhalation would have been below a level of health concern The results are presented in Table A15.

Comment 4: Your report states that if I have concerns, I should investigate possible health-related issues with my health care provider, yet neither you nor your office ever contacted me to make that suggestion or statement. All information I have received from your office has repeatedly assured me there was no reason for concern. Why wasn't I contacted and told I should follow up with my health care provider if I continued to have concerns?

On the basis of the results of all available Cenex site environmental sampling data, WDOH has no reason to believe that a health threat existed for staff or students at either of the schools. The results of the August 2000 indoor air sampling event conducted inside the high school revealed no site-related contaminants. ATSDR prepared a health consultation evaluating the August 2000 air sampling results and determined that chemicals detected in air at the Quincy high school (as well as the background schools) were not at levels of health concern, and do not pose a health hazard.

Although WDOH concluded that the site did not pose a public health threat to school staff or students, WDOH has indicated numerous times at public meetings that anyone with ongoing health concerns should see their primary care physician.

Comment 5: On April 11th, I believe, while again running a group of kids by the trees next to the Cenex site, I smelled what I believe was the same chemical that I smelled during the operation of the rinse/concentrating pond. Are any processes currently (this spring) going on which could conceivably allow fumes to escape into the atmosphere?

For a number of years, with Ecology oversight, Cenex has conducted various activities at the site, including soil vapor extraction, soil gas testing, new monitoring well installation, monitoring well testing, and testing of air sparging. It is conceivable that one or more of these activities could have resulted in localized, short-term odors, although WDOH is unaware of any particular occurrence. Ecology can be contacted for specific site-related activities and timeframes.

Comment 6: The report spoke of ingestion as the pathway into the human body. What about absorption through skin contact? What about inhalation? I did not see either of these entrance routes mentioned in the report. I believe both of these are much more likely routes of exposure. I mentioned, as noted in the report, the salty taste I kept spitting up, and the acidic burning I noticed in my eyes. Why haven't inhalation and absorption been

addressed as points of possible entry?

The health assessment assumed that exposures to contaminated soil occurred as a result of both ingestion *and absorption through the skin* (dermal absorption). Since the draft health assessment, WDOH has evaluated the dust inhalation pathway using an EPA particulate model. The modeled results indicate that exposure to site contaminants from dust inhalation would have been below a level of health concern. The results are presented in Table A15.

Comment 7: I believe this report is incomplete and therefore inaccurate. I would like to see a more complete study. There are questions about the sensitivity of the test badges used in the schools to determine exposure. Yet, the badges were not in place during peek times of possible exposure. Shouldn't accumulated dust from around the filter sites or air ducts also be examined?

On the basis of all available information (epidemiological data, site-specific environmental sampling data, indoor air sampling data, and particulate modeling results), WDOH concluded that the site posed a low health risk, and does not agree that a community health study is warranted. WDOH agrees that the original (February 1998) indoor air sampling investigation at the high school was not an appropriate method for obtaining VOC air samples. Results of a more recent (August 2000) and appropriate indoor air sampling investigation revealed no site-related contaminants, and no contaminants at levels of health concern. The testing was conducted to determine if VOCs present in groundwater and soil gas had migrated into high school buildings. WDOH and ATSDR recommended another round of indoor air testing in the high school during a different season to verify that site-related VOCs are not present at levels of health concern. This was done in November 2001, the results of which will be evaluated in a separate health consultation.

As a general indoor air quality recommendation, the school's heating, ventilation, and air conditioning (HVAC) system should periodically be inspected and cleaned. WDOH was informed that the high school HVAC system was completely replaced within the last several years. The previous system brought in outside air. The current system is a forced air system which circulates air within the confines of the building. WDOH was also informed that the junior high school HVAC system was replaced 10–12 years ago. The Washington State Department of Labor and Industries, private air quality consulting firms, and/or certified industrial hygienists should be contacted if further assistance is needed on these issues.

Comment 8: The conclusion: "No Apparent Public Health Hazard" is not justified because, based on our analysis of the cancer rates in Table 2, the table contains inaccurate calculations. The assessment's conclusion: "the number of cases occurring in Quincy was not different than what would be expected in a community of the same size and structure" could therefore be wrong. Our re-evaluation of Table 2 shows that the occurrence of Non-Hodgkins Lymphoma is significantly higher than expected at the 95% confidence level. That is a type of cancer that is associated with farm communities and herbicides. Because

different citizens who came to discuss their health problems with the Department of Health mentioned renalcell carcinoma and bladder cancer, we checked kidney and renal pelvic cancer numbers at the 90% confidence level and found the occurrence of kidney and renal pelvic cancer is significantly higher than expected at the 90% confidence level. We found additional problems with the calculations and urge you to re-evaluate the numbers.

At the request of a Quincy resident, we expanded the analysis of incident cancer cases occurring in Quincy to include all 24 cancer sites, cancers with unknown primary site (i.e., cancers diagnosed at an advanced stage for which it was impossible to determine the site where the cancer began), all other cancers, and all cancers combined, using all available data (i.e., 1992–1998). Further, we used an analytical technique which presents the results differently. The procedure used in the previous draft constructed 95% confidence intervals around the observed number of cases and observed whether this interval included the expected number of cases. This analysis is easy to perform and is typically used as a screening tool. For the final health assessment, we conducted statistical tests that assess how likely it is to have the observed number of cancer cases if the actual cancer rate in Quincy was the same as the state as a whole. We presented the resulting p-values, which estimate the probability of having the observed number of cases, or a number of cases which is even further from the expected number of cases based on the overall state average. This analysis was conducted for all cancer sites, and for all cancers combined, using all 7 years of available data for the Quincy zip code 98848.

This analysis indicates that the total number of cancer cases is significantly less than would be expected, and that there were significantly fewer cases of lung and bronchus cancer. “Unknown primary site” was the only category for which there was a statistically significant excess number of cancer cases than would be expected. Since these cases were different types of cancer, it is very unlikely that they would have had a common underlying cause. Non-Hodgkin’s lymphoma was not statistically elevated, with 11 observed cases and 10.3 expected cases ($p = 0.680$). There were 10 cases of kidney and renal pelvis cancer, with an expected value of 6. This difference was not statistically significant ($p = 0.09$).

The analysis conducted by the statistician working for the community members was somewhat different than that initially used by WDOH. In that analysis, the statistician assumed a Poisson distribution with a mean equal to the expected number of cancer cases and, for the cases where the observed was greater than expected, estimated the probability of getting at least the observed number of cases. This is roughly equivalent to conducting a one-tailed test where the alternative hypothesis is that the observed value is greater than the expected. In our current analysis, we use the same procedure, but we use two-tailed tests, where the alternative hypothesis is that the observed value is not equal to the expected value. That is, it might be higher or lower. This accounts in part for the different results obtained using these two methods.

Comment 9: Even without what might be an excess of cancers, it would be better to delay a final conclusion until you have the data from the additional tests at the high school and other testing.

Prior to finalization of this health assessment, WDOH expanded the analysis of incident cancer cases (see response to previous comment). In addition, WDOH evaluated dust inhalation exposures, three additional contaminants, and received the results of indoor air samples collected at the high school. On the basis of these data, and data already evaluated, WDOH feels there is sufficient information upon which to draw an overall health conclusion. If additional testing is conducted, WDOH can prepare a separate health consultation report evaluating the data.

Comment 10: I think the site warrants recommendation for a Community Health Investigation, one of the actions that could potentially accompany the "No Apparent Public Health Hazard" conclusion.

On the basis of WDOH's evaluation of all available site-related chemical information, and health outcome data for the Quincy area, WDOH does not agree on the need for a community health investigation.

Comment 11*:* No house dust was sampled in the community or at the high school. Citizens asked questions about house dust but the answers were not helpful. Dust can be a reservoir of past contamination from pesticides, which certainly could have occurred in Quincy, even though some of the site is now cleaned up.You could also request that the dust in the air filters at the high school be tested. Some schools do not clean them regularly.

See response to comment # 3 and # 7.

Comment 12: Better testing of the high school air should be done. In particular, lower detection levels for 1-2 DCP should be used.

WDOH agrees that the original (1998) indoor air quality investigation was inadequate. A more recent (August 2000) high school indoor air investigation was performed using EPA Test Method T0-14, which had greater sensitivity and reliability than the original 3-M badge tests. The August 2000 test results did not reveal any Cenex site-related chemicals. ATSDR prepared a health consultation report summarizing those results. To verify that site-related VOCs are not present in the high school at levels of health concern, WDOH and ATSDR recommended a similar indoor air sampling investigation inside the high school during a different season. Another indoor air investigation was conducted at the high school in November 2001. When available, the results will be evaluated in a separate health consultation.

Comment 13: Has local data been checked regarding the number of children with learning disabilities or the relative funds spent on this problem in the Quincy schools, compared to other school districts? Elizabeth Guillette found that in Mexico there is a big difference in the cognitive abilities of children who live and work in agricultural areas compared to children who live far from such sites.

WDOH has not checked the local data regarding the number of children with learning disabilities or the relative funds spent on this problem in the Quincy schools, compared to other school districts. WDOH has found some information in the scientific literature that suggests higher incidences of some cancer types for pesticide applicators and children living in agricultural areas, compared to nonagricultural areas (see WDOH response to comment # 1 in the draft health assessment). The purpose of this health assessment, however, was to evaluate the potential health risks associated with the Cenex site, not potential health risks as a result of areawide pesticide use. The commenter can refer to the Discussion section for a detailed evaluation of the health risks.

Comment 14*:* The groundwater is quite contaminated. Can't the Department of Health recommend testing if citizens are concerned about other wells? Although the health assessment says there are no other known private wells in the area, I understand there is a trailer park to the northeast with private wells. Also, EDB contamination at the Nielson Trailer park was mentioned by citizens interviewed for the health assessment.

WDOH does not regulate private domestic wells. We can provide well-testing recommendations, information on certified testing laboratories, and evaluate the results of such testing. WDOH has worked with Grant County to identify all at-risk wells (i.e., wells hydraulically downgradient of the Cenex site). To date, no individual domestic wells have been identified that are threatened by contaminants from the Cenex site. The area of groundwater contamination has been extensively studied through regular monitoring of at least 29 monitoring wells, and source removal and treatment is ongoing.

WDOH sampled for EDB in the Quincy area in the early 1990s as a result of contamination in a nearby water system. The sampling revealed contamination in the Neilson Trailer Park (now Country Corner) wells, located south of town. WDOH provided the system operator with health-effects information and directed the operator to distribute it to the water users. The system is under order to conduct quarterly monitoring, provide a small water system plan, obtain water system approval, and notify consumers about the chemical detections (Scott Fink, Ginny Stern, and Valori Adams, WDOH Drinking Water Division, personal communication, November 2000). EDB was found to be a regional problem following testing conducted by Ecology in the mid 1990s. EDB groundwater contamination has also been an issue in Whatcom and Thurston counties.

Comment 15: Why was there no specific attention to workers at the site, health problems in their families, etc.? They certainly suffered the highest exposures.

The results of the health assessment indicate that past exposure to site contaminants would have resulted in only a low health risk. Per state and federal occupational health requirements, employees should have appropriate health and safety training tailored to the specific chemicals handled during the course of their work. The Washington State Department of Labor and Industries (L&I) would be the appropriate agency to investigate and evaluate worker exposures.

L&I have inspectors and certified industrial hygienists whose primary function is to inspect, regulate, and monitor worker exposures.

Comment 16: Sometimes ATSDR health assessments take into consideration other sources of contamination (businesses, spraying of various kinds, disposals, and spills) in the community. Your approach might be because the request to WDOH was to assess problems caused by Cenex, but the site has likely exacerbated other problems caused by agricultural chemicals, and this possibility should not be ignored. The Grant County Local Emergency Planning Committee, which collects information about chemicals used, stored, and released by facilities in the community, would be a good source of information.

WDOH agrees that the Grant County Local Emergency Planning Committee could be a valuable resource *for general areawide issues* related to the storage, handling, use, and transportation of hazardous materials. The purpose of this health assessment was to evaluate potential health risks associated with the Cenex site.

Comment 17*:* I understand that no citizens have formally requested a study, but on the basis of past contamination from pesticide use and releases, and the concern expressed by the community members you interviewed, it might be helpful if the Department of Health could recommend that ATSDR do a health study for the Quincy community. Then other sources of toxins could be included.

See responses to comment # 7 and # 10.

Comment 18*:* ATSDR is looking at new research possibilities involving exposures to mixtures of chemicals, and also at some of the health problems that are on the rise, especially in children: asthma, attention deficit disorder, etc. The WDOH could recommend the Cenex site for research, since the toxic site was so close to a school and some of the children's parents might work there.

On the basis of the results of all available site environmental sampling data and health outcome data, WDOH has no plans to recommend that ATSDR conduct this type of research for the Cenex site. The kind of research the commenter suggests would require a larger exposed population, and exposures to contaminants at levels considerably higher than were present at the Cenex site.

Comment 19: We find the quality of the public health assessment conducted at the former Cenex Fertilizer and Fumigant Storage Facility in Quincy, Washington, to be of shoddy quality. Deficient in effort and scientific data, the conclusion of "very low risk" from past, present, and future exposures is questionable, if not suspect.

See response to previous comment. At the request of some residents, the following additional information was evaluated and included in the final health assessment; 1) evaluation of three additional contaminants, 2) evaluation of dust inhalation using an EPA particulate model, and 3) an expanded evaluation of incident cancer cases for the Quincy area. This results of WDOH's evaluation of this additional information did not change WDOH's overall health conclusion.

Comment 20*:* From a past exposure perspective, there was little or no effort made by WDOH to explore the health of persons known, or suspected, to have been exposed to contaminants during the operation of the site. Specifically, no effort was made to contact students and teachers present at the Junior and Senior High Schools during the 1986–1990 operating period of the Cenex site, nor to contact residents of adjacent neighborhoods. Cenex employees and others working in the area, e.g., Desert Electric employees, also were not contacted.

On the basis of our evaluation of all available site environmental sampling and community epidemiological data, WDOH concluded that the risk to the community as a result of the Cenex site was not high. Specific community health concerns are addressed in detail in the health assessment.

Comment 21*:* While interviews with past students, teachers, and Cenex employees (full- and part-time) would have provided the most accurate insight into exposure and past risk from the site, this was not done. Instead, estimates were made by assuming that the only route of exposure to chemicals on the site were from oral ingestion and dermal contact, as children and workers would have walked the site. No analysis was done of dust in the schools, or soils on the school property—now, or in the past.

WDOH sponsored an Open House in 1997 to hear health concerns from area residents. Those concerns are addressed in the health assessment. Data indicated that the site posed only a low health risk, and did not warrant the kinds of interviews the commenter suggests. Prior to removal of stockpiled contaminated soil/concrete in 1997, a small number of pesticides, herbicides, and metals were present at elevated levels at the site. Current soil contaminant levels are much lower, and the entire site has been covered with 6 inches of clean gravel. Regardless of the level of risk, WDOH has always maintained its availability to assist school staff or students with individual health concerns. At the request of the school district, Ecology and WDOH follow-up indoor air testing was conducted there in August 2000. The results did not reveal any site-related contaminants, and, on the basis of ATSDR's evaluation of the data, do not pose a health threat to students or staff at the high school. To verify that site-related VOCs are not present at levels of health concern, another round of indoor air sampling was conducted inside the high school (and at background locations), in November 2001.

In the health assessment, WDOH evaluated the potential health risks to persons who were assumed to be exposed to contaminated dust generated at the Cenex site using an EPA particulate emission model. The model indicated that exposures to contaminated dust originating from the site would not have posed a public health hazard (see Table A15).

Comment 22: Air quality monitoring, which had been discussed with WDOH repeatedly in 1996–97 while contaminated soils were on the site, was refused. Without this information, as you have pointed out, past exposure estimates via this most critical of pathways (inhalation) cannot be done—a major deficiency of this report which is directly attributable to the nonfeasance of the WDOH.

See responses to previous comments regarding dust exposures. The EPA particulate emission model referenced previously indicates that the health risks from inhalation of site soil contaminants would have been below a level of health concern.

Comment 23*:* Exposure estimates have been limited to only those chemicals on the site which exceeded MTCA cleanup standards. Alachlor, Atrazine, and Thallium also exceeded cleanup standards, but were not assessed.

WDOH estimated exposures for contaminants detected in soil or soil/sludge samples that exceeded ATSDR health comparison values. If an ATSDR value was not available for a particular contaminant, MTCA method B soil clean-up levels or EPA risk-based concentrations (RBCs) were used to screen contaminants for further evaluation (see data tables). *Alachlor, atrazine, and thallium have been included as contaminants of concern, are discussed in the health assessment, and are included in the data tables.*

Comment 24*:* The second issue relates to current exposure to the site, specifically the 1,2-dichloropropane spill that has now migrated under the high school. The technology used for assessing concentrations of 1,2-DCP in the high school was inappropriate. Ambient air tests run in February 1998 were conducted with the approval of the WSDOE using a technology whose detection limit was set higher than the reference concentration, the outcome of which might lead a trusting populace to believe that there was only one "hit" in the high school, as reported. The fact is the levels of exposure to students and teachers in Quincy High School remain unknown. Any conclusion of "low risk" from faulty data is remiss on the part of WDOH. Furthermore, it has now been over 2 years since Health and Ecology recognized this deficiency, yet nothing has been done by these agencies to facilitate timely and appropriate re-analysis to determine what concentrations might be present in Quincy High School. To remedy this deficiency, full air quality "canister" monitoring should be employed in not only the high school, but the adjacent junior high school as well.

Use of the 3-M passive dosimeter badges was not the appropriate method to measure indoor air VOC concentrations at the high school. More reliable and sensitive canister testing was conducted in the high school in August 2000, and no site-related contaminants were detected. To verify that site-related VOCs are not present in the high school at levels of health concern, another indoor air sampling investigation was conducted in November 2001. When the data become available, WDOH will evaluate the results.

On the basis of discussions with Ecology, the location and direction of the groundwater plume does not indicate that the junior high school is at any greater (and likely less) risk than the high school. If subsequent investigations indicate the presence of elevated levels of VOCs underneath the junior high school, or if the results of the most recent indoor air testing at the high school reveal site-related VOCs at levels of health concern, WDOH would consider recommending similar indoor air sampling for the junior high school.

Comment 25: The third area of concern are assumptions being made without supporting data. This includes assuming that

(a) The 1,2-DCP spill is not migrating “upgradient” towards two city wells and over a dozen private wells. To remedy this uncertainty, monitoring wells should be placed “upgradient” to prove there is no migration in that direction and drinking water wells should be tested for 1,2-DCP.

The only drinking water well identified to date that could conceivably be threatened by the Cenex groundwater plume is Quincy municipal well # 5, located about ½ mile east-southeast of the site. Well 5 draws water from a deep (340–350 feet below ground surface) aquifer. The presence of an intermediate confining layer is believed to restrict the movement of water between wells screened in the upper aquifers and wells screened at the same depth as municipal well # 5 (Feasibility Study, p. 4-3). The results of water level measurements from shallow and deep monitoring wells on and near the site indicate that groundwater flow in the Quincy area and underneath the site is toward the southeast (Feasibility Study, p. 4-2 and 4-4, and Figures 4.3 and 4.4). Quincy municipal wells #1, #2, #3, and #4 are located hydraulically upgradient (west) of the site, and should not be threatened by the Cenex groundwater plume. All five of the Quincy wells are Group A public water supply wells, and are regulated by WDOH. Because of the increasing threat of chemical contamination to Quincy municipal wells as a result of general areawide pesticide use, WDOH has been more closely evaluating the wells and has required more frequent sampling. The most likely use of the affected shallow groundwater is irrigation. Previous discussions and well investigations conducted by Grant County and WDOH did not locate any at-risk domestic wells adjacent to or downgradient of the site, in the vicinity of the contaminated groundwater plume.

(b) The Junior High School is not affected by the 1,2-DCP spill. With students at, or entering, puberty at this school, this student population is most vulnerable and should be included in all air quality monitoring efforts, and any soil and/or dust studies that are undertaken.

See response to comment # 24.

(c) Rates of cancer, other than the 10 mentioned in the health consult, are within expected ranges for our area. All cancers should be reviewed, not just 10, and the years of review should be expanded to include all available information. (Please note, that non-Hodgkin’s lymphoma and kidney and renal pelvis cancer rates are double what would be expected for a community of our population (Table 2, page 46), but have been shown

to fall within a range of “expected values” through a statistical tool called a “95% Poisson Confidence Interval.”

See response to comment # 8.

Comment 26*:* Finally, there are several discrepancies between the earlier draft of the health assessment and the one released to the public. Among these discrepancies are

(a) A reduced number of estimated cancers per chemical in the final draft.
Changes in the estimated increased cancers since the original draft were probably a result of slight revisions of exposure factors for individual chemicals, or slight revisions of exposure assumptions used in the health assessment.

(b) Language describing the hydrogeology of the aquifer into which the 1,2-DCP has spilled. The latest version has removed all references to “fractures and faults in the basalt” which make up the layers separating the aquifers, and to analysis performed that demonstrates groundwater “movement vertically” between the aquifers. Removal of this key language might support claims attributed to you by the Wenatchee World that “the two aquifers are separated by a thick layer of clay that water cannot pass through”—a statement clearly erroneous to a reader of the first draft.

Studies (i.e., pumping tests) have indicated little or no vertical connection between the shallow and deep water bearing units, and thus little chance that contaminants in the upper aquifer could impact the deeper aquifer. Any changes made in the health assessment concerning the nature and characteristics of the regional hydrogeology and lithology were intended to reflect the most recent information available. WDOH defers to the Remedial Investigation and Feasibility Study reports for a more complete discussion of local and regional hydrogeology and lithology.

(c) “BGS” is defined as “Below Ground Surface” in the narrative of the earlier document but not in the report released to the public. Instead, BGS is footnoted in the final document as “Background soil South,” presumably referring to a background soil sample south of the junior high athletic field. Or does this mean that this sample was taken from below ground surface? It’s interesting that the background soil sample wasn’t taken from the north side of the athletic field where it might have represented drift from the site onto school property—something that still should be done.

The “BGS” reference on page 13 of the draft health assessment refers to the depth “below ground surface” of Quincy’s municipal wells. The full name and acronym was indicated on page 13. The “BGS” acronym from Table 9, p. 64, of the draft health assessment refers to the background soil sample collected from the south border of the Quincy junior high school athletic field, and is indicated in a footnote below Table 9.

Comment 27*:* WDOH's deliberate use of inadequate and misleading information to arrive at the conclusion that there is a "very low past health risk" associated with the site is unacceptable and insulting. It demonstrates a lack of professionalism, a lack of concern for the people, and a bias toward corporate interests. Testing needs to be conducted to correct deficiencies noted in the public health assessment; to rule out current exposures to residuals from the site; and to expand the scope of testing to include the junior high school and neighboring residents. In addition, historical and geographical information should be reviewed for accuracy and corrected as needed.

On the basis of WDOH's review of all Cenex site environmental sampling and community epidemiological information, WDOH does not agree that additional environmental testing is warranted at the junior high school and neighboring residences. If the follow-up indoor air sampling conducted at the high school in 2001 reveals contaminants at levels of health concern, WDOH could recommend similar sampling for the junior high school. On the basis of the particulate emission model referenced previously, it is unlikely that past airborne exposures to contaminated dust from the site would have resulted in chronic health problems. Residual levels of pesticides remaining on the site are low and do not pose a health threat. In 1997, the site was covered with 6 inches of gravel, further reducing the chance for exposures. The current remedial action objectives include various proposals intended to further reduce the chances for exposures, such as asphalt capping of the site.

Certification

This public health assessment was prepared by the Washington State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health assessment was begun.

Debra Gable
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ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with the findings.

Richard Gillig
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ATSDR